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THE KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY.

EDITED BY

THEO. S. CASE.

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REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VI. AUGUST, 1882. NO. 4.

GEOLOGY.

NORTH PARK, COLORADO.

G. C. BROADHEAD.

On the 15th day of June, 1881, we passed west from Omaha, gradually ascending the mountain slopes. Approaching Sherman we observed the geological features to be very similar to those observed the year previous near Las Vegas, New Mexico, evidence of the extension of the same geological uplift. The red beds are seen and the "Hog-back" also seen at Las Vegas; and at Sherman the red granite is boldly prominent.

Between Sherman and Laramie City, in the distance, are seen remarkable weathering of columns of red beds capped with harder projecting strata, and away up the Laramie plains, twenty-five miles south of Laramie City, are seen the bold escarpments of red strata with the snow-capped Medicine Bow range beyond.

Laramie City, Wyoming Territory, a town of 3,000 inhabitants, is pleasantly situated on Laramie plains, near Laramie River, at an elevation of 7,126 feet above the sea. The Laramie plains are for about sixty by thirty miles nearly level and only interrupted by occasional dry valleys, and covered with sand having a scant growth of grass and some other plants.

From Laramie City to North Park our road will take us southwest, up Laramie valley and around the base of Jelm Mountain to Cummins City, or else our

route would cross the Laramie River three miles further up stream. By the former route we would pass through fifteen to eighteen miles of good pineries, (the *Pinus Contorta*) across the Medicine Bow Mountains and six miles further to Berry's at the entrance to North Park. Following the road by the Upper Ford we pass over a well-worn road through more open woods. On this route the stratified rocks present a fine section as we leave the plains, of which the following is an approximation:

1. 200 feet of white beds crowning the hill-top.
2. 1000 feet of red beds.
3. 36 feet of white gypsum with occasional crystallized laminæ.
4. 100 feet of yellow beds.
5. 100 feet of red and grayish beds.

The gypsum beds above named would be exceedingly valuable if nearer market.

Our route across the Medicine Bow Mountains is at an elevation of probably 8000 to 9000 feet above the sea, and of easy grade. The prevailing rock is a red granite, sometimes schistose and sometimes graphic, but on a part of the route is very much decomposed and at one place there is apparently a broad vein of white quartz. The approach to North Park is by a long sloping valley, along which flows a clear stream. At the entrance to the North Park is a gray banded gneiss traversed by occasional quartz veins. These rocks are seen for three miles along the valley from the granite of the mountains to North Park.

North Park is about fifty miles north and south, by thirty miles wide, east and west, and entirely surrounded by mountains. Southwardly over the Park we cross several good-sized clear streams of water, including the Canadian, Michigan and Jack's Creeks. Illinois Creek lies just west of the last and they all are confluents of the North Platte, which stream they join in the northern portion of the Park near Independence Mountain.

The exposed rocks in North Park are chiefly stratified sandstone and shales of recent age, probably none are older than the cretaceous. Owl Mountain is a high ridge of chiefly such rocks, projecting northwestwardly into the Park from the east and resting against the igneous rocks in the rear.

The Medicine Bow Mountains extend from about 100 miles north, passing southwest for one-half their extent, then trending nearly south to a point east of Teller City (the chief mining town located at the southeast corner of North Park) where they connect with the "Continental Divide" which trends off west toward Muddy Pass, forming the southern rim of the Park. They then pass off northwardly forming its western rim.

Spurs of these Mountains approach the North Fork of Platte River, north of the Park, and the Medicine Bow range approaches it on the east.

The Park is about fifty miles long thirty wide, and, according to Clarence King, has an average elevation of 8,500 feet above the sea. It is nearly surround-

ed by lofty mountains, reaching up 3,000 feet above the inclosed valley. It is covered chiefly with a dense growth of wild sage (*Artemisia*).

On our route from any point we can see snow-clad mountains on nearly every side. These snowy peaks impart a pleasant coolness to the various waters flowing through the valley. The water power of the streams flowing out from the mountains is sometimes great, that of Jack's Creek especially so. Its width fifteen to twenty-five and thirty feet, flowing very rapidly, falling in many places five to ten feet per 100 feet or 200 to 300 feet per mile on its mountain course. Strange as it may appear these streams contain but few fish, but just across the "Continental Divide" fish are abundant.

GENERAL GEOLOGY.

The Colorado Range and the Black Hills are archean. The Medicine Bow Mountains and the main Continental Divide are also archean. Through these archean rocks, igneous rocks of volcanic origin have pushed themselves up. Clarence King informs us (in Geol. Survey of 40th Parallel) that those on the south rim of the Park are trachytic, those flanking the western slope of the archean on the heads of Michigan River and Jack's Creek, he terms "Rhyolite," and further says: "From the meridian of 114 W. to California the Rhyolitic rocks 'cover a greater area than any other of the volcanic family, and in age are Post-'miocene, and were characteristic of the opening of the Pliocene." Mr. King defines Rhyolite as "a ground mass of fine-grained mingling of fragmentary crys-'tals of Sanidin (glassy feldspar) and crystalline grains of dark quartz, the color 'generally dark. At the head of the Illinois Creek the ground mass is lighter, 'and includes larger crystals of feldspar and fragments of quartz. Hornblende 'also occurs in small crystals. The middle of the ridge south of North Park is 'of Trachyte, which Zirkel calls a *granite-phorphyry*. The east wall of the Park 'is lined with Rhyolite. Basalts occur west of the Trachyte. Rabbit's Ear Moun-'tain and Buffalo Peak are of Basalt."—King, 40th Parallel Survey.

King refers the chief formations of the North Park basin to the Tertiary, leaving exposed at several places near the outer rim the underlying cretaceous.

The above, from King's Report, includes about all that has been written concerning the geology of this interesting region. Other surveys seem to have passed it by, but we infer that there were great disturbances and eruptions during the development of these trachytes.

Mt. Richthofen (probably the same as Lead Mt.) stands at the point of meeting of two distinct trends of the Rocky Mountain archean rocks. Within this angle occurs an extensive outpouring of rhyolite rocks; they flank the base of the archean for twenty-five miles, rising highest against Mt. Richthofen, when the volume of eruption was the greatest. In this vicinity the granitoid rocks are deluged by dark colored rhyolites.

Virginia City, Nevada, and the adjacent mines are on or near the extreme western extension of the great Rhyolite overflow; the southern and southeast

portions of the North Park lie along its eastern limit and just here there have been many mines opened within the past two years.

The line of junction of the Archean (granite, gneiss and mica schist) rocks with the volcanic (rhyolites and trachytic porphyries) rocks is about north and south, and near this junction are occasionally seen dolerytic dykes, whose strike is also north and south. The principal veins also extend in a north and south line parallel with the strike of these rocks, and they are nearly everywhere ore-bearing, and in some places rich in silver ore. The minerals in these veins as found may include: Sulphuret of silver; Ruby silver and other silver ores; Copper and iron pyrites; Oxide of copper and of iron.

Complete analysis may result in the discovery of other interesting ores and minerals. Calcite, Dolomite, Fluorite and Quartz are found at most of the mines. The veins vary from one foot to twenty feet in width, but those worked on are generally from two to five feet wide.

Passing up Jack's Creek from Teller, we find at Teller a dark trachytic porphyry traversed by doleryte dykes, having a north and south strike, but dipping to the west at an angle of 60 degrees. Similar rocks are found as we pass up the creek for three miles generally presenting the general appearance of metamorphic porphyries, but some have a decided schistose character. Beautifully banded and contorted gray gneiss is found a little way up from Teller.

At the "Gaslight" mine work was done on a coarse, gray porphyry twenty-five feet wide. Porphyry walls appear on the west with dolerite on the east. The gangue rock shows quartz in drusy cavities, with sulphuret of iron disseminated in the veinstone of quartzose rock. Both calcite and dolomite occur here in crystals.

The adjacent porphyry here is a gray with rather large light gray crystals. This mine was discovered in June, 1879, by Jno. and A. Lefevre, formerly from Missouri. It was the first mine struck on Jack's Creek and when sixteen feet down was sold for $20,000. In 1882 it was again sold when sixty-five feet down at quite an advance.

Above the "Gaslight" dolerite extends for a mile or more to the Pennsylvania mine, and the New El Dorado. At the "Yellow Jacket" mine the work was prosecuted on dolerite with poor success. White and green fluor and pyrites occur on the wall rock. At the "Pennsylvania" mine at forks of Jack's Creek, the walls are still dolerytic, with streaks of pyrites, carbonate and fluorate of lime and quartz and some silver.

The next mine, just above the last, is the "New El Dorado." It lies directly on line of contact of the volcanic rhyolites and dolerites with the gneissoid and schistose rocks. The vein, four and one-half feet wide, bears north and south, dipping a very little to the east and with ore well disseminated in quartz. Its east wall is dolerite, the west is quartz. Some galena has been obtained here.

The "Constellation" due north of the last and across Jack's Creek, high up the mountain, is supposed to be a continuation of the New El Dorado. The rocks

are similar. Ores from this mine are a dark gray with sulphurets evidently rich in silver.

From the New El Dorado to the Josephine the gneissic rocks show numerous beautiful foldings with bands of light and dark laminæ, and between these two lobes these rocks can be continuously seen. These gneisses were also found to abound in red garnets.

The "Josephine" is probably a continuation of the "Endomile," but they are 1,000 feet apart and the former several hundred feet higher on the mountain.

The "Endomile" appeared to be the richest vein and information since received confirms the opinion then advanced. The course of the vein is north and south, depth worked June, 1881, was thirty-five feet, and width at that depth four and one-half feet dipping slightly to the east. [Recent letters give a width of forty-five feet to the lode at 300 feet depth with distinct walls and rich ore].

At the centre of the vein a soft opening appeared, six inches to one foot wide, and carrying ore. A soft ore yielded by assay $217.80 per ton. West of the centre the ore-mass does not appear rich, but contains a good deal of pyrites. East of the centre the gangue is rich in sulphurets for two and one-half feet, the richer portion carrying ruby silver.

Fluor spar, both of violet and green tint, is abundant in the vein, occurring in vertical vein masses. Where the fluor chiefly abounds the ore is not so rich. A mass of ore thirteen inches wide shows fifty per cent. of ore thickly disseminated, yielding probably ten per cent. of ore which would assay over $400 per ton. A banded schist appears on the eastern wall, the western wall including much pyrites. Assays from this vein range all the way from $80 to $800 per ton. [The assays were made by Devlin and Shelton].

A number of other less important mines were visited, but the work was yet in its infancy. No smelting or machinery then. The deeper the rock has extended on the Endomile, the richer the ore has appeared. The geological relation of the rocks seems favorable, the strike and course of veins about the same, nearly north and south. The Endomile, the Constellation and Gaslight and some others show evidence of being true fissure veins. We need look here for no carbonates. Most of the mines are owned by the North Park and Vandalia Mining Company, Dr. G. W. Bassett, of Vandalia, Illinois, being President, and D. C. Holcombe, of Peoria, Illinois, Secretary.

About the year 1870 some mining was done on Independence Mountain by Jno. Lefevre and others, probably forty to fifty men in all. The Utes notified them to leave and not to remain over two sleeps; Lefevre and one other left, the others remaining were all killed. The Indians resided in the Park until 1878. In 1879 Antelope and his band were in the Park, remaining but a short time, but did not come up into the mountains where the miners were. They burnt the woods, doing great damage.

The first ranch started in North Park was Pinkham's in 1876, Walden's next, on Michigan River, in 1879, and Mendenhall's on the Canadian in 1880. In 1881 there were fifty or sixty ranches in the Park.

The first mines in the Teller District were discovered in 1879, and for a while there was a rush of miners, but most of them soon left and in part of 1879 and 1880 there were only five miners on Jack's Creek. These were Lefevre, Payson, Halstead, Latham and Fuller. The first house was built at the mines in 1879 and first house in Teller City in May, 1880. In June, 1881, Teller City had a population of about six hundred and one newspaper. Charles Smith was the discoverer of the "Endomile." Discoveries have been made all the way from Rabbit's Ear Mountain to Illinois Creek, but no real mining except on the east side of the Park. Mining has been done all the way from 9,000 feet elevation near Teller, up to the snow line, chiefly under the shadow of the thickly timbered mountain sides.

The wild game is fast leaving. In 1880 elk, antelope and black-tailed deer were continually seen. In 1881 the antelope could be commonly seen in the Park but were getting shy. The others had retreated to the mountains.

The Medicine Bow Mountains and those east and south of the Park are generally clothed with a dense pine growth (*Pinus contorta*). In many places the ground is covered with masses of fallen dead timber, sometimes even equaling one-fourth as many trees as those remaining erect, and making the way entirely impassable. Fires are sometimes very destructive. Three years ago the Utes set fire to the woods and thousands of acres of good timber were destroyed. Several times I saw as much as a thousand acres of dead standing trees, which gave a very desolate appearance to the landscape.

At one place I observed the pathway of a former snowslide. The avalanche had swept every tree even from its roots in its pathway from mountain top to valley, and was apparently not less than a quarter of a mile wide.

The pineries afford the material of which the houses are built, the shafts cribbed and long straight poles are hauled out fifteen to twenty-five miles into the park and used for fencing the ranches.

In Wet Mountain valley the aspen (*Populus tremuloides*) abounds and affords excellent fuel. Ascending the mountains over 9,000 feet elevation, the pine gives place to the spruce and fir, the *Picea engelmanus* being abundant. These grow to a large size and stand thick on the mountain sides. With these, and reaching high up the mountains, we find a dwarf huckleberry (*Vaccinnum myrtillus*). Around Teller we observed the strawberry, raspberry and currant. The wild sage (*Artemisia frigida*) and greasewood stand thickly over the North Park and abound on the Laramie plains. Several species of native grass, some very much resembling our blue grass, are abundant in the Park and on Laramie plains.

Of plants common to either Missouri or Kansas, I observed not over a dozen, including a *Delphinum*, the strawberry, *Cleome integrifolia*, *Malvastum coccinneum*, *Oxytropus lambertii*, *Dodecatheon meadea*, *Sysirhynchium bermudiana*, *Allium juncus*, and *Triticum repens*. There may be a few more.

Fremont in his second Report Across the Plains and Mountains in 1843 speaks glowingly of the flora in crossing the Laramie Plains and Medicine Bow Mountains. And he spoke the entire truth, for it is of remarkable beauty. The *Del-*

phinum, *Dodecatheon* and *Oxytropus* on the Laramie Plains and in the Park, the beautiful blushing *Lewisia* and the *Ocerothera Marginata* with its large white petals, the *Gillia aggregata* and others of the Medicine Bow range are very beautiful. Several species of *Psoralea*, the *Oxytropus* and others were very prominent in the North Park, and the plants in the caves and on the mountain sides are very interesting. Among the latter the *Aquilegia Cerulea* is most prominent, tall and very showy, and of the purest white and azure blue.

The *Berberis repens*, with its holly-like leaf and red berry is abundant in pine woods, and is said to afford the berry of which the "Vinegar Bitters" is made. The *Thlaspi alpestris* and *Trollius laxus* were found blooming beside the snow banks. The *Cleome integrifolia* very abundant in Kansas and Nebraska, also found on the Laramie plains but not in North Park. The *Primula parryi*, a very handsome plant, was found at the edge of a stream at 9,000 feet elevation.

The following is a partial list of plants observed and collected hurriedly. Many of them were collected at a moment's stop on a trip of fifty miles per day. [For their determination I am under many obligations to Dr. George Engelman of St. Louis.]

LIST OF PLANTS.

NAME.	Cheyenne to Sherman.	Laramie Plains.	Medicine Bow Mts.	North Park.	Teller.	Mountains S. of Park.	REMARKS.
Ranuculus Cymbalaria.				*			
Trollius laxus.			?		*	*	To snow line.
Aquilegia cerulea.			*		*		
Delphinum.	*	*		*	*		Several sp.
Berberis repens.			*		*		
Corydalis Montana.			*				
Arabis retrofracta.					*	*	High up.
Vesicaria ludoviciana.					*		
Vesicaria Montana.				*			
Cardannia cordifolia.					*		
Erycimum asperum.			*				
Thlaspe alpestre.			?		*	*	High altitude.
Cleome integrifolia.	?	*					In Kan. to E. line.
Viola ——.					*		
Arenaria fendleri.	*			?			
Calandrina pygmæa.					*		
Malvastrum coccinneum.	*						In Kan. & N. Mex.
Linum perenne.				*			
Geranium fremonti.					*		
Geranium richardsoni.					*		
Thermopsis Montana.				*			
Trifolium longipes.		*		*			
Trifolium parryi.					*	*	High altitude.
Oxytropus lamberti.		*		*			
Rubus ——.					*		
Geum triflorum.				*	*		
Fragaria Virginiana.					*		Common in Mo.
Potentilla fruticosa.				*	*	*	
Potentilla anserina.	*		*		*		

NAME.	Cheyenne to Sherman.	Laramie Plains.	Medicine Bow Mts.	North Park.	Teller.	Mountains S. of Park.	REMAKKS.
Rosa avicularis.					*		
Saxifraga bronchialis.					*		
Sedum rhadiola.				*			
S. stenopetalum.				*			
Lewisia rediviva.			*	*			Hills of N. Park.
Epilobium angustifolium.				*			
Oenothera marginata.			*				
Mammillaria vivipara.				*			
Lonicera involucrata.					*		
Sambucus pubens.					*		
Erigeron trifidum.					*		
Helianthus.				*	*		
Chænactis douglasii.				*			
Artemisia frigida.		*		*			
Pencedamum.					*		
Vaccinnum myrtillus.						*	High up.
Arctostaphilos uva-ursi.			*				
Primula parryi.						*	
Androsace septentrionalis.			*				
Dodecatheon meadea.		*			*		Found in Mo. & Ill.
Pentstemon humilis.				*	*		
P. glaucus.					*		
Castillæa pallida.					*	*	
Mertensia lanceolata.					*		
Eritrichium glomeratum.	*	*					
Phacelia sericea.				*			
Phlox coespitosa.		*		*			
Gillia aggregata.			*				
Eriogonum umbellatum.				*	*		
Rumex venosus.	*						
Polygonum bistortum.				*			
Alnus viridis var. alpinum.					*		
Pinus contorta.	?		*		*		
Picea engelmanni.					*	*	
Abies ——.					*	*	
Juniperis communis var. alpina.	*		*			*	
Sysyrhynchium bermudiana.				*			Common in Mo.
Veratrum album.					*		
Streptopus amplexifolius.					*		
Allium.					*		
Allium.		*					
Juncus baticus.	*						
Elymus sitarion.				*			
Triticum repens.	*	?		*			Common in Kan.
Stipa spartea.	*	*					

PLEASANT HILL, MO., June, 1882.

THE LOUP FORK GROUP OF KANSAS.

CHAS. H. STERNBERG.

This formation received its name from the Loup Fork of the Platte River, Nebraska, where it was first studied by Dr. Hayden, the eminent United States geologist. The rocks in Kansas consist chiefly of hard gray sandstone, or pudding-stone conglomerate, with beds between of loose, yellowish sand, or soft gray marl, the lime of which appears to be a sulphate, and was doubtless derived from the chalk of the Niobrara Cretaceous, that lies beneath. The experiment has often been made of burning this marl for building purposes, resulting invariably in various colored slags. There are also found beds of red clay and silica. Near Fort Wallace the hills are topped with thick masses of dendrite, the upper surface consisting often of chalcedony or "moss-agate."

Near Colyer, on the U. P. R'y (K. D.) on the high divide between the smoky Hill and Saline Rivers, Mr. Joseph Savage, of Lawrence, has discovered quarries of red, yellow and ribboned jasper belonging to this formation. At South Benner, in Rawlins County, are beds several feet thick, of fine silica, having a satin-like lustre. I had supposed from the exceeding fineness of the dust, and from the fact that it polishes the metals, that it was diatomaceous earth, but the microscope fails to show anything organic in it, only angular scales of transparent quartz.

My party left Buffalo Park, Gove Co., on the 20th day of July, 1881, and reached the fossil beds of Decatur Co. on the 23rd inst. Our first camp was on South Sapper Creek, ten miles southwest of Oberlin. Here we were very fortunate, obtaining a great many specimens of mammalian vertebrates in the soft beds of marl, sand and gravel. They occupied the spaces between the compact strata of sandstone and conglomerate. From two localities half a mile apart, we procured a number of bones and teeth of rhinoceroses, horses, mastodons, etc. One perfect skull of a rhinoceros was found with under-jaw and atlas vertebra in position. The rest of the skeleton had been dug out, evidently by other explorers, judging by the number of broken ribs that lay on and through a great pile of *debris*, near the bank in which we found our specimen. I suppose, as is common with explorers, that they took the long bones, vertebræ and arches. This skull was preserved in grayish sand, that could be easily removed with a knife. When it was a quicksand bog along the borders of the great Loup Fork Lake, the huge animals, with many others, became entangled, and dying left their skeletons which have been preserved so many ages, hidden from the sight of the denizens of that country who never supposed that they had repeatedly walked over the remains of these tropical beasts.

We found in the same locality in a space six feet wide, and about fifty feet long, a number of other specimens, including jaws with teeth, and bones of two species of rhinoceros, bones and teeth of horse and mastodon.

Four species of the rhinoceros have been described by Prof. E. D. Cope from the Loup Fork Group of Colorado and Kansas under the genetic name of *Aphelops*. I quote from the Bulletin of U. S. Survey: "The dental formula is, Incisors $\frac{2}{1}\frac{1}{1}$, Canines $\frac{1}{1}$, Premolars $\frac{4-3}{3}$, Molars $\frac{3}{3}$, Digits 3-3. Nasal bones with persistent suture, weak—not supporting horn. This genus occupies a position intermediate between *Aceratherium*, Kauf., and *Rhinoceros*, Linn. It agrees with the former in the presence of incisor and canine teeth, and in the absence of indication of nasal horn, but differs from it in lacking the fifth digit of the anterior foot. In the last respect it is identical with *Rhinoceros*, differing from it in characters already mentioned." We procured specimens of the *Polydactyle* horse in this locality, as well as part of the lower jaw of a *Mastodon*. It resembles Prof. Cope's *M. Productus*, described in Lt. Wheeler's report as from the Loup Fork Group of New Mexico. "In this species the underjaws are prolonged into a beak, which bears two powerful tusks." I imagine that they might have been used by the animal for digging up succulent roots, in the vast swamps through which he wandered. Although mastodons have been described in Europe with inferior tusks they are certainly unique.

In the vicinity of our first camp, we worked several days and procured about two hundred teeth, a number of perfect bones from various species and individuals. In one place the bones and teeth were scattered and evidently worked in by a stream, as they were packed in between pebbles in a kind of mortar, the bed resembling the so called "concrete" of the west. Many of the bones were water-worn, and they lay through the matrix without any system. A rhinoceros tooth often close to that of a horse, or of some other species and bones of different species, are indiscriminately mixed. These animals had doubtless died on the shore and high water had rolled the bones along with pebbles; the water holding in solution chalk and sand that had cemented them together, when they found a resting place in the deep waters of the lake. The specimens were often so closely wedged in between the pebbles that it was hard work to get them out without breaking them.

Another camp was made on Beaver Creek near Cedar Bluffs, north of Oberlin, where some beautiful collections were made of bones and teeth of the horse, camel (?), rhinoceros and a carnivore. One set of underjaws of a horse had most of the teeth in position. The canines were about the size of a small goose-quill. We got also three perfect toes, *i. e.*, the metatarsals, of one limb. The central one was twice as large as the lateral ones. A number of small bones, and teeth of various species were washed out of a denuded knoll, the material of which seemed to be composed largely of chalk. The bones were white, and the teeth showed the plications of the colored enamel. Near this camp we found the under-jaws of a young mastodon, showing the milk dentition. It was in loose soil, grass roots penetrated the specimen in various directions, consequently it was impossible to save them in perfect shape.

On South Beaver, Rawlins County, we found a locality (through the kindness of the surveyor of the county) rich in fossil land turtles. We collected about

twenty specimens representing different stages of growth; some quite small, showing the elegant markings of the shells, ridges and grooves following the outlines of the plastron plates. Some specimens were nearly perfect, lacking, however, the skull. A number of nearly perfect limbs and arches were obtained. They were found in a narrow gulch where the water had cut through twelve or fifteen feet of white sandy marl. The specimens were sticking out on either side of the perpendicular banks. During October, at the Museum of Comparative Zoölogy, Cambridge, I was able to get some of the specimens into very respectable shape, though the specimens have still fragments with them, and it requires time and patience to fully restore them. I believe they have been described by Prof. Cope under the name of *Xerobates cyclopogius*. They are but little petrified, which is the case with all the Loup Fork fossils. I have always found that fossils partake largely of the characters of the rocks in which they are preserved. If it is hard and dry the specimens are well preserved and the breaks are usually angular and rarely mended. Specimens are generally well preserved in loose, dry sand, in chalk, and in hard clay concretions. The older the formation the more perfect is the petrifaction. In some cases the bone is entirely replaced by silica. Where the matrix is largely composed of clay it cracks and crumbles on exposure to the atmosphere and it is very difficult to save the specimens unless they are preserved in concretions impregnated with iron. In recent formations, unless the bones are perfectly dry, they usually crumble easily, and it is hard to mend the fragments, the cement used is apt to tear loose and take part of the bone (especially spongy bone) with it. Further, if any fragments have been left in the field the difficulties of restoring the specimen are greatly augmented.

One trouble the explorer meets with in northwestern Kansas is from the fact that so few fossil beds are exposed, the slopes of the hills are so gradual that the greater part of the country is covered with grass and soil. The south sides of streams are the ones usually denuded. I suppose this is because the streams, flowing as they do in a northeasterly direction, cut the southern sides, and in addition the higher bluffs protect that side from the south wind and the sun so that snow and moisture remain there longer, giving Jack Frost a chance to break off great masses of rock which, rolling down the bluffs, cover their sides and prevent the growth of grass to some extent. On the southern sides of the Sappa and Beaver Creek are often seen bluffs a hundred feet or more in height with bold escarpments rising one above the other, while between them are beds slanting backward of the soft fossiliferous marls. Where the marls are perpendicular caves are often cut in them by rain finding a crevice in the hard cap above, to rush through and wash away the softer rock.

In one of these caves Mr. Wright of my party found where an Indian had been buried and took away a few glass beads. He found it rather dangerous work getting down from the over-hanging rocks into the mouth of the cave and still harder to get back again. I believe I may take to myself the credit of being the first to explore these beds in northwest Kansas. For, though collections of mammalian bones had been found by Profs. Marsh, Mudge and others in the con-

glomerate beds lying above the chalk along the Saline and Smoky Hill, thus indicating what would likely be the result of an exploration in these beds, those gentlemen were too much interested in the Niobrara reptiles and birds to spare the time for extended explorations in a formation where at best it was uncertain whether any very valuable or new material would be found. While exploring the Niobrara of the Smoky Hill in 1877 an old-time hunter named Abernathy (who was killed by the Indians on the Sappa in 1878) told me of a large mastodon skull that he had seen projecting from a ledge of rocks on Sappa Creek. I had little faith at first in what he told me, but at last becoming more convinced by his oft repeated assertions I followed his lead, and after traveling seventy-five miles I found by his directions the mastodon skull, which proved to be a large land turtle shell. I remained some time and collected eighty land and fresh water turtles, besides some valuable bones of mammals, which are in the hands of Prof. E. D. Cope, of Philadelphia.

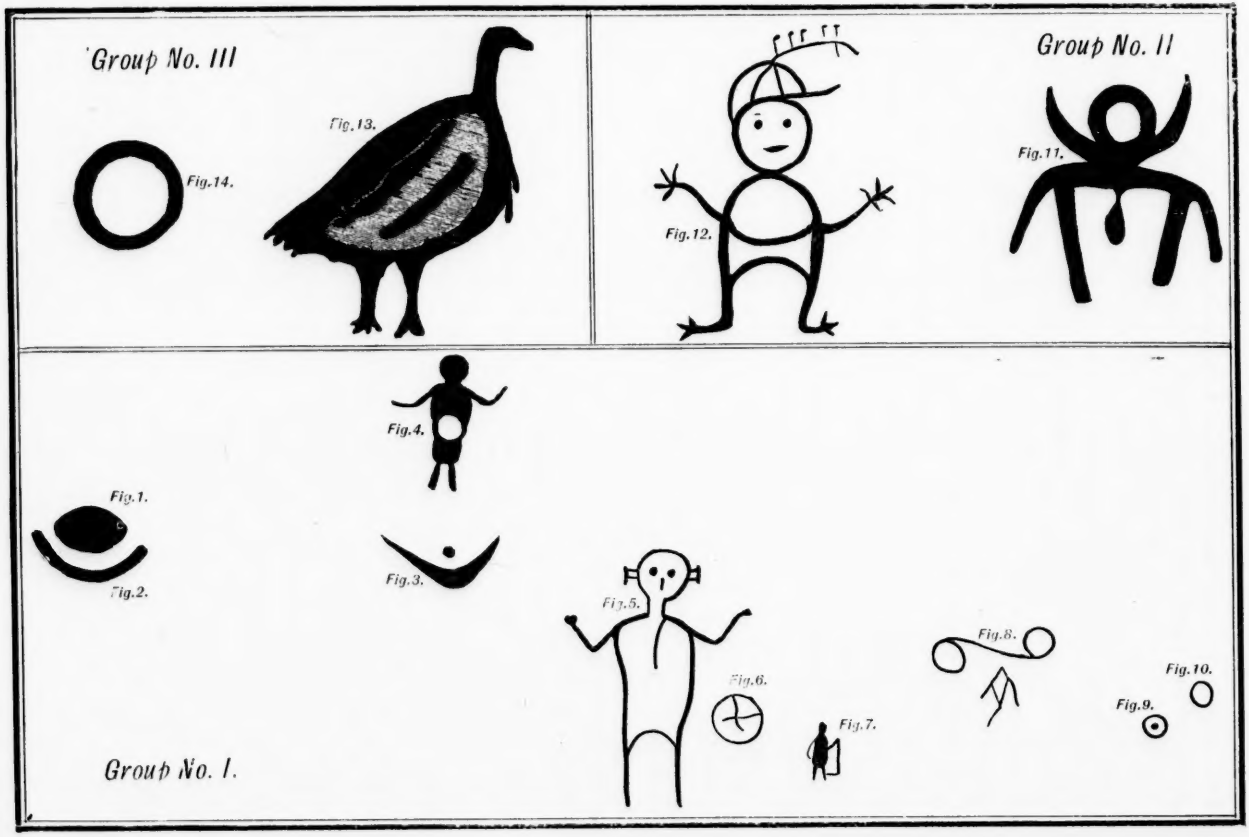
ARCHÆOLOGY.

INDIAN PICTOGRAPHS IN MISSOURI.

CHAS. TEUBNER, JEFFERSON CITY, MO.

During a visit to Columbia, Boone Co., Mo., last fall, I learned that the bluffs on the Missouri River below Rocheport, which is situated in the extreme southwest corner of the same county, contained a number of pictures painted in red on the face of the cliffs, the supposed work of Indians. Trustworthy informants assured me that these figures were known to the oldest inhabitants, and I found several who saw them thirty five or forty years ago. Lately, in passing through Rocheport, I concluded to take a look at them, and therefore made my way to the farm of Mr. L. Torbett, about four miles east of Rocheport, where, as I was informed, they were located. Mr. Torbett's farm also contains eight or nine mounds, some of large size. His house is built on one of them, the smokehouse on another, and there are two more in the rear and to the right of the house. The site of the house is a commanding one, and affords a fine view of the surrounding country, while at the same time the neat cottage, with its sloping lawn dotted over with stately forest trees and the green mounds in close proximity to the house, present a pleasing appearance from the road.

Receiving a hearty welcome from Mr. Torbett and his excellent wife, and after refreshing the inner man with a substantial dinner, I was supplied with a guide in the person of L. Torbett, Jr., a bright little lad, and together we wended our way eastward from the house, hundred yards or more, and then turned south through a small corn field, at the edge of which a short path led down a steep


Group No. III
Fig.13.
Fig.14.
Group No. II
Fig.12.
Fig.11.
Fig.4.
Fig.1.
Fig.2.
Fig.3.
Fig.5.
Fig.6.
Fig.7.
Fig.8.
Fig.10.
Fig.9.
Group No. I.

ravine, densely overgrown with trees and vines, from which we soon emerged to find ourselves on the banks of the great turbid river. Following the banks a distance of one hundred yards down stream we came upon a spring, which made its appearance some thirty feet above the surface of the river, at the head of the alluvial and cliff deposit, lying in a steep slant against the cliffs. Coming out of a cave-like opening, it rushes in a series of zigzag leaps over moss-covered rocks into the river. The volume of water is large enough to drive a good sized flouring mill. The face of the cliff from the outlet of this spring extends upward nearly one hundred feet, the top overhanging six or eight feet, giving the whole a concave appearance, which accounts for the preservation of the pictographs. At the height of forty-five feet, immediately over the spring, is the largest group of pictographs (No. I). About five feet beneath the figures a narrow ledge extends along the cliff which served as a foothold for the artists. The ledge is accessible from points east and west of the pictographs, but it requires a person of no ordinary nerve to climb up to it.

The relative position of the figures in group 1 corresponds with those on the cliff.

This group seems to indicate the record of some important event, as the human figures express wonder, though the other figures are such as to leave one in doubt as to their significance. Commencing at the west end of group 1 we come to Fig. 1, of oval shape, 8x10 inches in diameter, surrounded by Fig. 2, a semicircle, which measures 14 inches across the ends, and is 2 inches wide. Fig. 3 somewhat resembling an Australian boomerang, measures 15 inches across the end and is one and one-half inches wide near the angle; the dot above it measures a little more than an inch; Fig. 4, length 13 inches; Fig. 5, length 25 inches; Fig. 6, diam. 4 inches; Fig. 7, length 6 inches; Fig. 8, diam. of circles 4 inches, distance apart 8 inches; Figs. 9 and 10, diameter 2½ inches, 6 inches apart. There are several more figures to the right of and belonging to this group, but they were grown over with American ivy (Ampelopsis Quinquefolia) to such an extent that I found it useless to try to sketch them.

A few rods west we find group No. II at about the same altitude containing two very striking figures. Fig. 11 is very distinct, about 7 feet above a ledge easy of access, and measures 13 inches each way. Fig. 12 represents a man, with an ornamental head dress and frog-like extremities, also expressing surprise. Some 300 yards up the river group No. III is located, with three more figures, one being nearly obliterated; of the remaining two, Fig. 13 is a good representation of a turkey almost life size. The other, Fig. 14, is a circle of 16 inches in diameter. These last figures are fifteen to twenty feet above any foot-hold, and could not have been reached without the aid of a ladder. The paint used was the so-called "keel," which had been ground up and mixed with water or fat, and applied with the fingers, or a rude brush.

ANCIENT REMAINS IN MARION COUNTY, KANSAS.

MELVIN O. BILLINGS.

Marion, Kansas, is situated on the northwest quarter of Section five, Township twenty, Range four, east of the sixth principal meridian, near the confluence of the Cottonwood River and Muddy Creek, a portion being in the valley between the streams and a portion on the hill east of the Muddy.

That this was at some time a far more densely populated city, is evidenced by the fact that in excavating almost every well, cellar or cistern, relics of an ancient inhabitancy are found and we are honoring this "Buried Race" by building our prominent buildings, churches, schoolhouses and best residences, near and over their principal monuments, their mounds. The relics of aboriginal inhabitancy may be divided into three classes, Mound-Builders, Crematers and Modern Indians. Of the first class only it is our intention now to write.

The mounds from which we denominate this class "Mound-Builders" are situated on high ground around the junctions of streams adjacent, in irregular groups averaging eight mounds to the group. Inside of three miles each way from Marion there are five of these groups. These mounds measure from ten to sixty feet in diameter and from one to three and one-half feet in height. In none so far examined have been found human remains. The larger ones consist of earth, stones, pebbles, broken implements and utensils of all kinds, shells and scraps of bone, all of which seem to indicate that they are only heaps of kitchen scraps and camp debris. The smaller mounds seem to be the remains of adobe huts or wigwams, mostly of clay which bear the appearance of having been partly burned; in these are found ashes, charcoal, broken pottery and a few broken bones, but they do not contain the profusion of articles which the large ones do. Some of these small mounds, after being subject to the plow and weather, are covered with flint chippings and and broken flint implements, showing that they were the workshops of arrow makers or the place where the refuse of this character alone was deposited. All mounds contain more or less shells, quartz, pebbles, concretions and peculiar little stones that to-day would interest a boy as being "funny." The small mounds are circular while the large ones have on the southeast side a spur about one-fifth the size of the mound. This is not the exception but the rule. As to the use of these large mounds with their spurs we have no theory. We are simply stating the facts as they are.

The fire beds, so named for want of evidence of their being graves, are relics of the same people, which is clearly proven by their contents being identical. One of these beds is described by Judge West in this REVIEW, No. 2, Vol. IV. Another found three-quarters of a mile above the junction of the Cottonwood and Muddy Creeks, on the creek bank exposed by gullying, is of the same shape as the one described by the Judge, *i. e.*, conical, and measured in depth six

feet – width, where clay and soil meet, three feet nine inches: from bottom to where clay and soil meet, three feet—width, at bottom, five feet one inch; contents: flint chips, broken pottery, worked bone, shells, pebbles, ashes, charcoal and a fine arrow point, the only whole instrument found.

Other remains of these people are found in cellars, wells and cisterns as befor stated. These are not graves, as no human bones are found therein. They are small masses of debris from camp, apparently, with occasionally broken implements and rarely whole ones. In excavating a cellar in Marion east of Muddy, at a depth of two and one-half feet one of these "places" was found. About thirty five feet west in digging a kitchen foundation, at a depth of ten inches another was found; both containing broken pottery, flints, etc., and the first charred corn. In digging a cistern between the kitchen foundation trenches and at a depth of eleven inches red clay was struck, which had no appearance of having been disturbed. Twenty-six inches of this undisturbed clay was gone through when a darker clay of the same quality was found, also undisturbed to a depth of twenty-eight inches, when a few bits of charcoal and a small amount of ashes were found. This was followed twelve inches, where upon a bed of ashes were found a rub-stone, a fine flint knife, some fragments of pottery, a beaver's tooth and a peculiar stone tablet.

Taking these and the ashes away they were found to have been in a bowl artificially hollowed from the natural limestone formation. Depth of bowl, bed of ashes and relics, nine inches; making a total distance from surface to bottom of bowl, seven feet two inches.

THE TABLET OF THE CROSS.

F. F. HILDER.

In the July number of the REVIEW which I have just received there is an article by Mr. Warren Watson on "The Tablet of the Cross," which contains some errors that I am tempted to reply to. The purpose of the article appears to be a criticism on the value of Prof. E. S. Holden's researches in the extremely interesting field of "The Hieroglyphics of Central America," which that gentleman has been pursuing with commendable earnestness and with promising results. The critic refers to an article on the subject written by Prof. Holden which appeared in the *Century Magazine* for December, 1881. He says: "In the article referred to Mr. Edward S. Holden gives the result of his researches in this field, with so much *eclat* that the reader is almost ready to admit his claim as discoverer of a clue to the difficult problem. This clue is the result of the study of a segment of hieroglyphs from the celebrated "Tablet of the Cross" at Palenque, and this being the fact a grave doubt arises as to the value of his discovery."

Mr. Watson then refers to Stephens' well known work and quotes from it, that the right or east slab of the three which formed the tablet "is broken, and unfortunately altogether destroyed."

He also states that Prof. Holden gives a cut of the entire tablet, the east portion bearing the signature of C. F. Trill, calls the cut a piece of patchwork and says it forces him to seek the source of Mr. Trill's drawings in the works of earlier explorers.

I can assure Mr. Watson that he need not seek so far for it, and that he has wasted considerable labor in making a list of such early explorers, as he can see the veritable missing east or right stone of the Palenque tablet by traveling to Washington, D. C., where it is safely deposited in the National Museum, also that Prof. Holden did not use in that part of his work the drawings of either earlier or later explorers, but had the stone itself under his inspection, with a photograph of it for use in the study.

Further on Mr. Watson says "other drawings are said to exist in various Spanish, Mexican, and Central American collections; but none, other than those mentioned, have been given to the world in any publication accessible to students."

This statement is certainly erroneous, as a very excellent work on the "Palenque Tablet," written by Prof. Chas. Rau, was published by the Smithsonian Institution in 1879, in which is given a very fine illustration of the whole tablet as restored, and a photograph of the east or right slab taken from the stone itself.

To this book I beg to refer Mr. Watson for a full history of the whole tablet and an account of the manner in which the right or east slab reached the National Museum, where it has been since 1858. I also refer him to the "First Annual Report of the Bureau of Ethnology 1879–80," published at Washington, D. C., 1881, in which Prof. Holden gives a very full and lucid account of his labors and the sources from which he obtained the necessary data. I think that before Mr. Watson attempted to criticise work done by such a thorough scholar as Prof. Holden he should have made himself more thoroughly acquainted with the current literature on the subject.

THE TABLET OF THE CROSS.

PROF. OTIS T. MASON, WASHINGTON, D. C.

EDITOR OF THE KANSAS CITY REVIEW:

Dear Sir,—A short article in the July number of the REVIEW affords me the opportunity of renewing our acquaintance too long neglected. I have had the pleasure of reading Professor Holden's article in the *Century Magazine*; but, if he is correctly and fully reported by Mr. Warren Watson, he has done great injustice to the Smithsonian Institution, to Dr. Charles Rau, and to the talented artist Mr. C. F. Trill.

In 1879, the Smithsonian Institution issued No. 331 of its Contributions to Knowledge, entitled "The Palenque Tablet in the United States National Mus-

eum, Washington, D. C., by Charles Rau." Among the many useful illustrations in that volume is a reconstruction of the Palenque Group by Mr. Trill, done under the eye and by the direction of Dr. Rau. From this restoration, doubtless, Professor Holden has drawn his material.

Now for the "east inscription, joined to Mr. Catherwood's in a clumsy fashion." I will quote from Dr. Rau: "Among the objects of archæological interest transferred to the Smithsonian Institution, in 1858, from the United States Patent Office, were several fragments composing a large rectangular stone slab, covered with glyphic designs in bas-relief, which had been presented to the National Institute by Mr. Charles Russell, Consul of the United States at Lajuna, on the Island of Carmen, State of Campeche, Mexico. The fragments had been obtained at Palenque, and reached Washington in 1842, * * * . The National Institute received at the same time a letter from Mr. Russell, dated Lajuna, March 18, 1842, in which he stated he had sent to the National Institute per ship "Eliza and Susan," fragments of a tablet from the ruins of Palenque, and by the "Gil Blas" other pieces of the same tablet which made it complete"

Mr. Titian R. Peale asserts that the pieces exactly fitted, and had a cast made of them in 1848, for Baron von Gerolt, Prussian Minister, by Clark Mills. In 1863, Professor Henry charged Dr. George A. Matile to make a new mould, in order to obtain a perfect cast. While thus engaged, Dr. Matile recognized the Smithsonian tablet as one of the three stone slabs which, placed together, bore on their surface the sculpture of the famous Group of the Cross. * * * . The middle slab and that originally joining it on the left have been described and figured by late explorers, but the one which completed the sculptured group, and is now preserved in the Smithsonian building, probably was already broken into fragments before 1832, when Waldeck explored the ruins of Palenque.

Stephens, who was there eight years afterward, certainly noticed its scattered pieces. It has not, therefore, been represented by either of them; but Del Rio and Dupaix, to whom we are indebted for the earliest reports on the ruins of Palenque still saw it in its proper place." I shall not follow all the incidents in the history of the slab. Dr. Valentini, in 1873, on receipt of a photograph, rediscovered the fact that the Smithsonian slab completed the Group of the Cross, never having heard of Dr. Matile. Finally Dr. Rau conceived the idea and executed it in 1879, of presenting the celebrated bas-relief in its original completeness.

Dr. Rau in his succeeding chapters discusses Explorations of Palenque, the Temple of the Cross, the Group of the Cross, Aboriginal writings in Mexico, Yucatan, and Central America, and closes with notes on the ruins of Yucatan and Central America. Finally the work is published under the acknowledgement of S. F. Haven and H. H. Bancroft.

I would say, in conclusion, that I watched Mr. Trill, day after day, carefully bring out his drawing, and so far from exhibiting any clumsiness, I think it was the one thing needful to justify the ingenious conceptions of Dr. Matile and Dr. Valentini.

Dr. Rau's work has been translated into other languages, notably into Spanish, by the Museo Nacional de Mexico, together with a fac-simile of Trill's reproduction.

NOTE.—We have also received notes from Dr. Rau and Prof. F. W. Putnam confirming the above.—[ED. REVIEW.

HISTORICAL NOTES.

PENALOZA'S EXPEDITION TO QUIVIRA.

JOHN P. JONES.

The recent publication of a translation from the Spanish, with notes, of Father Freytas' narrative of Penaloza's expedition from Santa Fe, to the rivers Mischipi and Quivirai n 1662,* has added new material to the history of the valley of the Missouri, and renewed the oft discussed question as to the location of Quivira.

Among the subjects for investigation, especially interesting to the students of history who are investigating that of the Missouri Valley, which this narrative suggests are the following: Did the expedition reach the Mississippi River? If so, at what point? Was the Quivira of Coronado the same as that of Penaloza, and did both expeditions reach the same locality? Did the Province of Quivira lie east of the Missouri River? Who were the people of Quivira, and what Indians are referred to as Escanxaques? How did the word Quivira originate?

As to the point reached by the expedition, the translator of the narrative says in a note to the writer of this article, that he makes a conjecture, and hopes the Missouri antiquarians will be able to determine it. His conjecture is as follows: "The short distance advanced along the river after the bend and the fact 'that the town was on a river entering the Missouri from the east seems to 'point to the rich lands on the Platte. The high ridge would be the line of bluffs 'enclosing the bottom lands along the Missouri."

It is possible this conjecture is right, but there are difficulties in the way of endorsing it as the true solution of the problem. The expedition consisted of eighty soldiers with officers, and one thousand Indians, well armed and equipped for peace and war, with a train of thirty-six carts well provided with provisions and munitions, a large coach, a litter, two portable chairs, six three-pounders, eleven hundred horses and mules. If we are to believe that the narrator has truly stated the magnitude of the Penaloza's force and accompanying train, we are bound to assume that a journey from Santa Fe to the junction of the Platte and Missouri, would be one of serious difficulty for it to accomplish in the spring of the year, when the rivers on the route would be swollen with their annual snow-

* The expedition of Don Diego Dionisio De Penaloza, governor of New Mexico, from Santa Fe to the Mischipi in 1662, as described by Father Nicholas de Freytas, etc., by John Gilmary Shea, New York, 1882.

flows. None are mentioned however, and the journey is described as one of pleasure and delight. Their route lay eastward for two hundred leagues, through pleasing, peaceful and most fertile fields, without hill or range, which finally ended at a very high and insuperable ridge, near the sea, eight leagues beyond the great city of Quivira. Through these pleasant and most fertile fields we marched, says Father Freytas, during the months of March, April, May and the kalends of June, and arrived at a large river which they call Mischipi, where we saw the first Indians of the Escanxaques nation.

If the expedition had really arrived at the Mississippi, it would be another link in the accumulating evidence, which is tending to show that the river was quite well known before LaSalle explored it, but that they were far from reaching it, we believe the narrative itself shows. The Spaniards probably knew by report that there was a large river called Mississippi, running north and south two or three hundred leagues east of Santa Fe, and consequently were prepared, after traveling as far as they had, to call the first great river they came to by that name. By holding a course eastward from Santa Fe they had probably rambled among the tributaries of the Arkansas, until they reached the parent stem, not far from where the Verdigris and its several branches enter from the north and east. That it was the Arkansas rather than the Mississippi or Missouri, several statements in the narrative tend to prove.

The most positive that can be quoted is probably that in which the narrator says they forded it in the night. After having been joined by the Escanxaques who numbered 3,000 warriors (probably 300) they marched along the river for two days and camped opposite the city of Quivira. During the night the Escanxaques slipped off and attacked the city, upon learning which Don Diego ordered the army to cross the river which they did by fording. That this could not take place on the Mississippi, nor on the Missouri near the mouth of the Platte in the month of June, I think no one will deny, while it might have taken place on the Arkansas.

The palatable plums and large, fine grapes of extremely good flavor, are fruit much more likely to be found south of the Arkansas in early summer than in the vicinity of the Platte, while the planting of their fields twice a year as mentioned by Father Freytas, their houses of cane covered with straw, their gifts of Indian corn, beans and pumpkins, all indicate a climate like the region of the Arkansas River in the month of June, rather than the Platte. The very high and insuperable ridge, which ran along the right side of the city toward the north, might have been one of the hill ranges of the Ozark mountains. The very deep rivers of Quivira which the Father describes as suitable to run canals for irrigation are more likely to be found in some of the branches of the Arkansas with their deep cañons, than in the broad but shallow streams of the more northern prairies.

Dr. Shea quotes Father Escalante, a missionary explorer of the last century as expressing the belief that Quivira was the country of the Pawnees. This view is not inconsistent with the theory that Penaloza's expedition found the province on the waters of the Arkansas. To the Spaniards, Quivira was the unknown

country, to be sought after by exploring expeditions, and if we accept the theory that the expedition of Coronado in 1542 found it near the 40th degree of latitude, it does not follow that Penaloza, one hundred and twenty years later, found it in the same locality. There is nothing to warrant the belief that any special country, located with boundaries, had ever received the designation of Quivira. It was the unknown, which lay beyond the country inhabited by the Indians that visited Santa Fe, and one locality was as likely to be so designated as another; but admit that it was the country of the Pawnees. Coronado describes the people inhabiting the villages which he visited, as living in huts of hides and willows, and says they changed their abode with the, buffalo. This is a correct description of the nomadic tribes of the Platte country, but does not agree with the customs of the people inhabiting the Quivira of Penaloza, yet I have no doubt that they were different branches of the same tribe. Marquette on his map of 1674 locates one village of the Pawnees southwest of the Arkansas and another south of the Missouri. DeLisle on his map of Mexico, 1703, has the tribe located on two streams entering the Arkansas from the south. On his map of Louisiana, 1718, he has Pawnee villages scattered from the Arkansas in the south, to the region of the Platte in the north. Upon the advent of the French into the valley of the Mississippi the Pawnees were the frontier tribe, that is, they occupied the most advanced locations on the waters that flowed east to the lower Missouri and the Arkansas. One of their villages near the Arkansas was visited by M. Dutisne, of Kashaskia, in 1719. It contained one hundred and thirty cabins, was situated upon a hill shut in by a prairie, by the banks of a stream. From there, it was fifteen days journey to the Padoucas which tribe they fought to the death. There were other villages of Pawnees north and west of the one visited by M. Dutisne.

From the views that I have expressed it will be seen that I do not believe that Penaloza reached the Mississippi, or that the Quivira of Penaloza was the same as that of Coronado, in other words that the former did not reach the vicinity of the Platte River, as conjectured by Dr. Shea. Also that the Quivira of Penaloza was not east of the Missouri River, but on the Arkansas. I do believe the people of Quivira, found by Coronado and Penaloza both, were Pawnees, and that the Escanxaques were the Padoucah's of the French or Comanches of the Spaniards, though there is a suggestion of the Algonquin A-Kan Sea in Escanxaques.

KEYTESVILLE, MO., July 10, 1882.

CABOT'S MAP OF THE WORLD.

CAPT. E. L. BERTHOUD.

(*Translated from No. 251, June 12, 1882. of L' Exploration.*)

Twenty years ago my learned and venerable friend Mr. Ferdinand Denis, my father and myself, had with a genuine geographical appetite of choice selection, studied closely the great world map of the National Library. We had already finished a commentary of it, when we resolved not to pass over one line of a very long "Legend" which accompanies this map. Suddenly one of us cried out, a *discovery*! that is no longer doubtful. Effectively we read in the first column on the left, Note 8, thus written:

"This land was discovered by John Cabot, a Venetian, and Sebastian Cabot, his son, in the year of our Lord and Savior Jesus Christ, MCCCCXCIV (1494), the 24th day of June, at 5 o'clock in the morning. To this land has been given the name of 'First Land Seen,' and to a big island near the said land, has been given the name of 'Saint John,' for having been discovered that same day. —— —— ——."

Thus we see, only two years after the discovery of Columbus, in 1494, and not in 1497, that John and Sebastian Cabot, had reached *terra firma* at the northeast extremity of the New World, not far from the Tierra de los Baccalaos (Land of codfish, New Foundland.)

We did not make much of a fuss over our little discovery; we did not think there was great glory in reading and interpreting a legend that many others could have known also. We, however, communicated our discovery to a savant of the French Institute, who a little less modest than ourselves, took the honor of the discovery upon himself.

Sebastian Cabot's map merits a more critical and deeper study. The date of its publication reaches back to the year 1544. The contour of South America is almost wholly shown, except a portion of Western Patagonia, and the south shore of Tierra del Fuego, whose name is not indicated. The eastern shore of America is pretty well drawn; the western shore stops at California.

The discoveries gathered up in the several expeditions of John and Sebastian Cabot are well indicated in this world chart, which was in course of preparation for many years, and which was given to the engraver only about 1541.

The first expedition of Cabot (after several failures) dates thus: the 24th day of June, 1494. The second one of 1497 was a 300 league cruise along the east coast of North America, that from the region first seen, "Tierra Prima Vista" in the first voyage, to the end of that sea "Mar descubierta par Yngleses" whose littoral was not landed upon.

The third expedition due exclusively to Sebastian Cabot, mentions the encounter of icebergs in Lat. 56° to 58° North, in the month of July, 1498, then a landing afterward on New Foundland.

The fourth voyage, undertaken by Sebastian Cabot alone, mentions his reaching the Latitude of 67° 30′ N. on the date of June 11, 1517, probably in Baffins Bay? —— ——.

RICHARD CORTAMBERT,
Librarian of the National Library, Paris.

NOTE. — Capt. Berthoud informs us that he owns Sebastian Cabot's map with the "Phrima Vista Land" marked upon it.—[ED. REVIEW.

ENGINEERING AND MINING.

THE IMPROVEMENT OF THE MISSOURI AND MISSISSIPPI RIVERS.

HON. R. T. VAN HORN, M. C.

(*Extracts from Speech delivered in the House, June 15, 1882.*)

* * * * * * * *

The problem of the improvement of the navigation of the great rivers of the United States is one involving elements as various as the character of the rivers themselves. What is suited to one is not adapted to another, and the obstacles in one differ from those in another. For example, let us take the Mississippi and its two great tributaries—the Missouri and the Ohio. What is adapted for the Missouri is not applicable to the Upper Mississippi and the Ohio. And when I refer to "Upper Mississippi" I mean above the mouth of the Ohio, and the "Lower Mississippi" that portion below that point. And what is practicable for the Upper Mississippi, the Missouri, and the Ohio is not so for the Lower Mississippi. In the former the difficulty is not enough water for continuous and permanent navigation; in the lower river there is too much water.

The different methods demanded is from the differing characters of the rivers. In the Ohio and Upper Mississippi the beds of the rivers are rocky and gravelly the shoal places being unchangeable from that fact. The problem is to remove these rocky and gravelly shoals and to concentrate the water of the river in defined and permanent channels. The banks, too, are permanent, owing to the tenacity of the soil, and but little subject to abrasion. This is demonstrated in the navigation of those rivers by the fact that pilots run their boats by landmarks from year to year; while in the Missouri they run by the surface indications and bends of the river, landmarks being unknown. The Missouri, from the Yellow-

stone to the mouth, is an inclined plane of sand, not a rock or gravel shoal in the entire distance, nor a rapid. Its banks are for the entire distance alluvial and are abraded with the smallest force of current and rapidly dissolved. The problem, from this fact, is not to deepen the channel by removing bars, rocks, or deepening shoals after the method in the other rivers, but to prevent abrasion and confine the waters at given points to a narrower channel, when it deepens itself.

It is not my purpose to be tedious as to the characteristics of the river, only to state them broadly, so as to show the methods to be employed. The same plan of appropriations that is employed in the Ohio and Upper Mississippi, is not, for this reason, applicable to the Missouri. In the former given points are selected and appropriations made for each. The same plan has been adopted heretofore in the Missouri, and no good results have followed. The present bill is the first that recognized the true method, and I take this occasion to thank the Committee on Commerce for its wise and statesmanlike action. The appropriation is in bulk, to be applied continuously, so as each year to complete a section of the river in a permanent manner.

Allow me, Mr. Chairman, to briefly sketch the character of the Missouri River. From its sandy bed and the alluvial character of great valley through which it flows its course is serpentine, from bluff to bluff. When the current strikes a bluff, where it meets the rocky barriers that underlie all the bluff formations of that valley, it shoots off by a sharp curve across the alluvial bottom-lands until it impinges on the opposite bluff, to repeat the same indefinitely.

Now, the fact is, that where the river washes the base of a bluff it is narrow and deep, with abundance of water in the channel for the heaviest transportation possible to the business to be done. But when it leaves a bluff to cross the bottom to another bluff, by the abrasion of the banks it is widened, sometimes from 1,200 to 1,500 feet under the bluff to a mile and a half on bottoms. The enlargement of the channel retards the current, creates eddies by the friction interposed by the shoaling process, precipitating the sand and soil held in suspension, and bars and shallows are the result. It is a curious fact that this law of the river results in giving to the river one general feature that characterizes its centre course. This is a succession of pools along the bluffs, with shallower channels connecting these pools, the pools overlapping, or extending uniformly above the point of connection with the cross channels.

Now, the problem is to prevent the excessive widening of these cross-channels, or to confine the abrasion within limits that will produce a depth of channel adequate to the demands of navigation. For example: If the pools have at low water a depth of 20 to 30 feet, as they have as a rule, with a width of 1,500 feet, by confining the cross-channel of a mile or a mile and a half with four feet of water to half a mile, we have a channel of 12 feet—the problem is solved. I use these figures as comparative.

Now, can this be done? The engineering skill of the country says it can, and the practical experience and observation of river men agree with the engineers. In fact they see it done in detail every year.

The real facts which call for the improvement of the river arise from the irregular operation of the same principle. If the snags, steamboat wrecks, and other obstructions in the channel of the Missouri had been methodically deposited they would have solved the problem long ago, and to-day we would have had deep and permanent navigation in the river. That this is not overstating the case scores of examples exist along its course where a lodged tree or a sunken boat has radically changed the course and character of the river for miles, in instances improving the navigation of the river exactly as the engineers now propose to do, but when the elements were adverse, carrying destruction and devastation in their wake. In fact it is the accumulated evidence afforded by these accidental obstructions upon which the engineers have based their p an of improvement.

There is only one thing to do to prevent the unnecessary washing of the banks at these points of crossing referred to, and the river will take care of itself. If the banks of Missouri were of the character of those of the Ohio, with its bed of sand, it would have always been the finest navigable river of the continent. Facts exist all along its course for a thousand miles that demonstrate that even its *debris*, where lodged favorably by accident, has done just what it is proposed to do under this appropriation. I cannot state it more simply or more forcibly than by saying that it is proposed to follow the example of the river itself in these improvements. There are places in the river to-day that if the snags in one bend were deposited systematically along a few hundred feet of cross channel, boats for fifty miles would find at all seasons a depth of water ample for all purposes of navigation.

I think I have stated the elements of the problem involved in the improvement of the Missouri River sufficiently broadly to give the h use an idea of the plan, and why the appropriation asked for has been given in bulk to be expended, not in removing bars, rocks or shoals from the channel, but in controlling the vagaries of the current or the waters, and allow them to do at exceptional points exactly what they do in the general channel of the river. There is not a single feature of the river proper to be changed, no interference with its laws or any of its peculiar characteristics. It simply is proposed to leave it as nature would have it if its banks had been less alluvial or capable of a little more resistance to the abrading force of its waters.

The problem, as an engineering one, is based upon the true principle of aiding nature, rather than resisting her forces. It is proposed to let the river take care of its own improvement. Its waters are the force employed. It is not proposed to provide new banks or confine its waters within mud walls—only to concentrate at the exceptional points its waters, that the volume may as elsewhere deepen their own channel.

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I now come to the second problem in the great river system—the Lower Mississippi. I favor the amendment providing for an outlet, and regret that the committee have not incorporated it in their bill.

I regret also, Mr. Speaker, that this question has been allowed to drift into an antagonism that demands the sacrifice of one or the other plan. There is no necessity for this, but on the contrary there is every reason why both should go together.

I have shown that the problem of the upper river was too little water; that of the lower is too much water. Is it not a common-sense proposition that you cannot treat these two problems by the one method? In the one case you have to control the water within the river banks so as to provide at shoal places a deeper channel. In the other it is to get the superabundant waters within the river banks. Will the plan of the one answer for the other? It is simply impossible, because the trouble is in the two cases directly opposite in character.

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We know that the money already appropriated has not been expended because the flood-waters have been in the way. Now, we contend that if the river had had more discharging capacity the waters would have been within the banks and that money have been expended for the use intended. And why not open more discharging capacity? What is the cause of the overflows of the Lower Mississippi? It is, stating it broadly, because the mouths of the river are not big enough. This fact comes from two causes, the slow current near the sea, and the consequent precipitation of sand and mud held in suspension. These causes result in narrowing the channel as it approaches the sea. The fact that by actual measurement the inflow at average floods at Cairo is 1,475,000 cubic feet of water per second, and that after receiving the waters of all rivers below, the flow at New Orleans is only 1,100,000 cubic feet per second, tells the story of the disastrous annual overflows. This surplus water must go somewhere, and the only place for it is to overflow the adjacent country. To confine this immense flood within artificial walls, built of the mud the river takes up and carries down to choke up its own discharge, is, I submit, one of those stupendous follies which sometimes fascinate men merely from the fact of their magnitude and from the vast sums of money involved.

That new mouths will draw off the water just in ratio with their capacity is as plain a proposition as that a barrel of water will be depleted by opening the bung-hole. The river below New Orleans, with a fall of one and one-half inches to the mile, has a flow of six feet in a second. The proposed Lake Borgne outlet, with a fall of two and three-fifths feet to the mile, would have a corresponding increase of current and consequent discharging capacity. But only calculating the flow at ten feet per second, with a width of one mile and ten feet deep, its discharge would be 528,210 cubic feet of water per second, or one-third of the whole inflow at Cairo. But the current would be more than twenty feet per second, or a capacity nearly equal to the whole river at Cairo. The mere statement

of the figures shows the ample character of the proposed outlet for the drainage of the highest flood ever known.

Why then is this self evident plan opposed? It is upon the assumption that if you let the water out through these new mouths the channel will be shoaled. No other objection having any practical bearing can be made, or can be urged to stand a moment, in view of the difference in cost—the outlet being estimated at $250,000, the other plan at $50,000,000. Is the objection a valid one?

I contend that it is not only without support in fact, but is based upon a false assumption as to what the outlet plan is. These outlets only propose to drain the flood-waters, not to make new river channels. When the river is within its banks now, navigation is just as desired. All the outlets propose is to keep the water from overflowing the banks. How, then, when the river is within its banks, or bank-full, in October, and at its maximum excellence for navigation, can it be destructive to navigation when in precisely the same condition, in March or July? That is all the outlets propose to do—to keep the river at this maximum at all seasons. They are not deep enough, and cannot be made deep enough, to affect the normal channel of the river, or the quantity of water in it. Or in other words, the channel of the outlet is ten feet deep, while the river channel at the outlet is 100 feet deep. How is this outlet to drain the river dry, or shoal it? It simply draws off the flood-waters, leaving the normal channel unaffected. But we are not left to theory. The United States topographical engineers by measurement at crevasses have demonstrated that the operation of these openings actually deepens the channel below the point of outlet. And this is exactly what is claimed for its effect—that the river confined within its banks by its increased current deepens its channel.

It is upon this theory that the Missouri River improvement is based, and I am not illogical enough to deny the operation of the same law in the Lower Mississippi that obtains in the Missouri. But it is upon this very fact that the improvement of the navigation of the Lower Mississippi is based. It is claimed at points where bars interfere, that by works which will confine the waters to lesser space the channel will be deepened. Now, if the water confined to the normal width of the channel on a bar deepens the water, why not the channel be deepened and improved when the whole river is confined within its banks? The statement is the answer. It is the object of all our appropriations, of all our surveys, of all our plans, to keep the river within its banks, natural or artificial. If, as is contended, when we build the banks higher in order to confine the water, it will deepen the channel, will not the same effect result if the waters are confined within the natural banks? It needs no argument; its demonstration is a fact known to every practical navigator of the great rivers of the West.

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I beg the House to remember one fact, that the advocates of the outlet system have only assumed one thing—the mere cost of making it. Every other fact connected with it is from the highest engineering authority ever known in this country; is copied from the official report of the board of engineers of the Army

of surveys and investigations made under the authority of Congress during a protracted period of ten years, embracing everything connected with the river at high and low water, as to levees and embankments, navigation, currents, the bed of the river, its floods, and all phenomena. We assume nothing; we have no theories, no experiments, no hypotheses; simply the fact that water runs down hill, that it is not compressible; these re-inforced as to results by ascertained facts by the most thoroughly applied scientific methods.

And what is the plan here proposed? Let me state it simply. As now, the river has below New Orleans a current that moves over a bed with a fall of one and one-half inches per mile. The distance is 120 miles. Ten miles below New Orleans the Gulf of Mexico approaches to within five miles of the Mississippi by an arm known as Lake Borgne. The river thus reaches the Gulf level at a point 110 miles less than now, or in five miles we reach the same level that the river now does in 110 miles. Gentlemen can discount the drainage capacity of thirteen feet fall in five miles in the one case, and the same fall in 110 miles as now, in the discharge of these surplus waters. That is all there is to the proposed Lake Borgne outlet.

Now, the fact to be ascertained is, will it prevent overflow to be restrained or confined by artificial banks? The plan has been tried, and has failed. By both experience and theory it will require artificial banks to be constructed from four to ten feet high for a thousand miles. Is it practicable as to money cost? and if so, will it hold the water? Both must be answered in the negative. We have found that it is difficult to confine even canal waters by artificial banks. How, then, the mighty floods of the Mississippi?

Again, the experience of the ages is that just as you raise the banks of a river you decrease the force of its current, until, as in the case of the river Po, in Italy, the river bed is above the level of adjoining lands. That river, after centuries of leveeing, now runs across the low lands on a ridge. But keeping a river within its natural banks deepens its channel, cutting out its bed to the proper angle of fall to the sea. It requires no science to know this; every washout in the farmer's field illustrates and demonstrates it. The only question of a practical nature in this connection is, can you get outlet enough? I have shown that you can.

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It has been shown by facts, in plain measured feet, that the proposed outlet cannot affect the river channel. Why not make it? It will be observed, Mr. Chairman, that these objections to the outlet are not made as formal engineering ones: they are the mere advocate arguments before the committee: there is another one used among members, but carefully kept from the record. This argument is that the outlet would injure the jetties. This is so new and novel that it is done in a whisper. The old soothsayers were said to laugh in each other's faces when alone. The habit did not die with the soothsayers.

Now, I can speak on this subject without fear of criticism, for from the be-

ginning I favored the jetties, and have not changed. They do not need this disingenuous argument, nor, even if they did, are they sacred or of more importance than the valley of the river. Let us look at this for a moment. It is shown that the river is a hundred feet deeper than the outlet at the point of junction. As the jetties are only twenty-four feet deep there is abundant water for them. We have shown that 1,100,000 cubic feet of water per second pass the point of the proposed outlet. The same high engineering authority tells us that only 83,000 cubic feet per second enters the pass in which the jetties are. So that there is all the jetty pass can carry and a million cubic feet to spare. No wonder this objection passes by a breath and is carefully kept from paper. It is not discourteous to say the objection is not an honest one. It either reflects upon the intelligence of the person to whom it is made, or upon the candor of the one who makes it. No friend of the jetties will put the objection on that ground, for it at once raises the question of good faith and of their utility.

To set this objection at rest, let us refer to the facts upon which the jetty legislation was based and those alone upon which the annual drain for keeping them open is made upon the Treasury. The jetties are based upon the simple fact that water is incompressible; that if you confine a stream of flowing water, of say half a mile wide, so as to make it pass between walls a quarter of a mile apart, the water will find room for its volume by cutting down its bed. That is all there is to the jetties. If the bed is of soft material, like sand or mud, it will cut it out. If it is hard clay or rock it won't, and then it makes a dam. Now the best advice I can give those who urge this objection against the outlet is to be very careful how they handle the subject, for if they once let go the theory on which they got the money to build the jetties, they turn them into a dam, and Congress may discover that a dam raises the flood-line of of the river, and vote money for the outlet to carry off the surplus waters.

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LEADVILLE AND VICINITY.

A recent trip to Lake and Pitkin Counties in Colorado, and a summary inspection of the wonderful mining regions included in them, especially in the vicinity of Leadville, east of, and in the Independence District, west of the Sawatch Range or Continental Divide, leads me to give your readers a brief description of them, although the former, at least, has been the theme of hundreds of writers within the past three or four years.

Leadville is situated in Latitude 39° 15′, Longitude 105° 17′, on the eastern side of the Arkansas Valley, between the Mosquito Range and the Continental Divide, at an elevation of 10,025 feet above the sea at the court house door. The first discovery of ore was made in 1860 in California Gulch, and for several years placer mining was carried on quite successfully, not less than $5,000,000 of gold having been taken out up to 1878. At the time of the Hayden Report

of 1873 several valuable lode claims were being worked for gold, while carbonates of lead and copper, iron pyrites, zinc blende, etc., were found. A vast body of iron ore was also reported by Hayden, "carrying gold enough to pay moderately," also, "excellent galena carrying silver in the quartzites near the iron vein." No indication, apparently, was observed of the vast quantities of silver ore that have within four years brought the district to the position of the richest mining camp in the world and caused Leadville to leap from a grubbing town of two or three hundred people to a thriving city of nearly 20,000. At that time two mines, the "Printer Boy" and the "Pilot" were yielding less than $50,000 per annum, now more than thirty mines are being worked, producing $13,170,576 in 1881.

The geology of this region is quite difficult to understand except by the most extensive generalization, as will be seen from the following description by Dr. Hayden: "On the summit between Mosquito, Bird's Eye and Evans Gulches broken masses of the quartzites and trachytes seem to have moved down a considerable distance from their places and are deposited in the form of windrows as if there had been glacier movements there. * * * One of the peculiar geological features in this range is the trachytic beds, which appear to be interstratified with the older sedimentary rocks. These igneous layers vary much in thickness, and appear and disappear, reach a thickness of 1,000 feet or more, and diminish in a short distance to a few feet or disappear entirely. And yet upon the outcropping of the great uplifted ridges, or in the deep gulches where not unfrequently 2,000 vertical feet of rocks are shown in their order of superposition, these trachytes seem to have flowed out over the surface of the Silurian quartzites or, in other words, are interstratified among the old silurian limestones and quartzites as if they might be of the same age and have been elevated with them."

S. F. Emmons, Geologist in charge of the Rocky Mountain Division U. S. Geological Survey, in his "Abstract of a Report upon the Geology and Mining Industry of Leadville, 1881," describes more minutely the peculiar geological features immediately about Leadville, as condensed by the *American Journal of Science* for July.

"The Paleozoic rocks of the Mosquito Range have a thickness of 4,050 to 5,600 feet and are more or less folded and faulted. They comprise (1) 200 feet of Cambrian or Primordial, chiefly quartzites; (2) over these, 200 of Silurian (*white* or dolomitic limestone and quartzite); and (3) 3700 to 4200 of Carboniferous, which last have 200 feet of limestone, called the *blue* limestone, at base and 1,000 to 1,500 at top (Upper Measures), with grits (Weber grits), sandstones and shales, partly calcareous, between. In the Kanab section on the Colorado, the Paleozoic has about the same thickness (85 feet of it referred to the Permian); but in the Wahsatch section cited, the thickness is 30,000 feet, 12,000 referred to the Cambrian, 3400 to the Silurian and Devonian, 15,000 to the Carboniferous and 650 to the Permian.

Besides these there are eruptive rocks—porphyries and diorytes—mostly Mesozoic in age. The common kind is the white porphyry, an evenly granular rock, consisting of quartz (70 per cent.), feldspar (the latter occasionally in small rectangular crystals), black mica or biotite, and some muscovite. The rock is partly decomposed, and the muscovite "is the result of the decomposition of the feldspar." Other kinds of porphyry, more granite-like, consist of quartz, two feldspars and biotite, and in one variety horn-blende is present. The dioryte is a porphyritic crystalline granular variety. The white porphyry occurs to the south of an east and west line through Leadville, and the other kind north of this line. The main sheet of the former which lies upon the surface of the blue limestone forms, at the Four-Mile Creek where is its principal vent, the larger portion of a hill 2,000 feet high, and thence spreads southward reaching nearly to Buffalo Peaks. On Iron and Carbonate Hills it has a possible thickness of over 1,000 feet; but along Evan's Gulch it will scarcely average 100, and even thins out entirely. Other sheets occur between lower strata, and there is a local sheet in the lower quartzite or Cambrian. The intrusive masses of the other porphyries have a wider vertical distribution, "extending up to the Jurassic and possibly even to the Cretaceous." A single section exhibits "fifteen sheets, many several hundred feet thick, between the blue limestone and the top of the Carboniferous." The various sheets of porphyry form an integral part of the sedimentary series; they never reached the surface, but were spread out and cooled between deep-lying strata—laccolith-like, before the mountain-building epoch at the close of the Cretaceous, and therefore before the associated strata were folded or faulted. Archæan rocks make large parts of the Sawatch Range on the west, and of the Front Range on the east, and their areas must have been great islands in the Paleozoic seas. "The Paleozoic and Mesozoic beds are a littoral deposit around the Sawatch Archæan Island and were consequently formed in comparatively shallow waters."

Of later formations, the region contains only the Quaternary; what have existed of Mesozoic strata—probably not less than 10,000 feet—having been removed by erosion and abrasion.

Several faults occur, the more prominent of which have the strike of the rocks, or about N. 60° W. and the upthrow on the east side; and, of these, the Mosquito fault, west of the main crest of the Mosquito Range, amounts on the north to 5,000 feet or more. Besides these there are many cross faults."

On the Pacific side of the Continental Divide the geological formations are similar, but the mountain sides are more precipitous and more heavily covered with loose material of every possible variety, while the upheaval and displacement have been even more complete. The ores so far discovered are principally gold in fissure veins rather than in pockets, but as comparatively little work has been done yet all may take a different phase after more complete development.

The ore of Leadville is described by Mr. Emmons (condensed as before by the *American Journal of Science*) as principally argentiferous galena and its secondary products lead carbonate, silver chloride, and, less abundantly, lead sulphate or anglesite, pyromorphite, minium, zinc blende and calamine. The gangue, or

material mixed with or holding the ore, consists of hydrated iron oxides or manganese oxides, silica and clay, all secondary products, the clay coming from the decomposed porphyry. The cavities in the limestone were made by the eroding solutions which introduce the ores; the action commenced at the top of the limestone adjoining the sheet of porphyry, and from this plane worked downward into the limestone. The materials of the ores were taken from "circulating waters, which, in their passage through the various bodies of eruptive rocks, took up certain metals in solution, and, concentrating along bedding planes, by a metamorphic or pseudomorphic action of replacement, deposited these metals as sulphides along the contact or upper surface, and to greater or less depth below that surface, of beds generally of limestone or dolomite but sometimes also of siliceous rocks." Dikes intersecting the ore-bearing formation "seem to favor the concentration of rich ore-bodies or bonanzas in their vicinity;" but the planes of faults afford no deposits of importance, and evidently for the reason that "their origin is later than that of the original ore-deposits." Thus the intrusion of the igneous sheets preceded the production of the ore-deposits and of the cavities containing them; and the production of the ores antedated the era of great disturbance which closed the Lignitic period or the Cretaceous, and which has continued to be followed by feeble movements until the present time, even since the opening, according to some evidence, of the Leadville mines.

These ores occur, according to the same authority, underneath a porphyry sheet and chiefly in cavities penetrating the lowest member of the carboniferous formation, the *blue* limestone—but occasionally also underneath the same porphyry in the *white* or silurian limestone and the Cambrian quartzite. The ore deposits penetrate into the limestone to varying depths from its plane of contact with the overlying igneous rock, sometimes following courses of natural joints or cleavage planes.

The product of the Leadville mines for the past six months has been about $7,815,000, which if kept up for the whole year will exceed that for 1881. Even this showing would be larger had it not been for the burning of the Grant smelter in June, which necessitated the sending of large quantities of ore to Pueblo and Denver, the returns for which had not been received when the above statement was given out.

The mines over the Range in Pitkin County are being actively worked and the prospect is that the Farwell Company at Independence will find abundant work for both stamp mills from their own mines, as they are driving the Dickerman Tunnel with all the men they can work, are also developing the Mt. Hope Mine and have their larger mill full of ore now; while those of Ide, the Hamilton Company and others promise well. The last named company are not at work on theirs at present, but are securing patents to their placer and lode claims, after which they propose to resume active operations. C.

PHILOSOPHY.

REVIEW OF STALLO'S "CONCEPTS OF MODERN PHYSICS."

DR. ROBERT G. ECCLES.

The thirty-eighth volume of the International Scientific Series is a statement in excellent form of the weak points of Modern Physics. Following the volumes by Cooke, Stewart, Lommel, Lockyer, Wurtz and Young, nothing could be more opportune or better calculated to display the spirit of fairness of the managers and publishers of the Series. The true spirit of science refuses to shield any theory from attack, and firmly believes in the final triumph of the best. The projectors of this literary enterprise have shown, from first to last, a keen appreciation of this spirit and a determination, as far as they could, to foster it. Stallo's "Concepts of Modern Physics" is a further guarantee on their part that they will be impartial to the last while giving the public the best thoughts of the best thinkers concerning the meaning of our multitudinous experiences, common and scientific. The author hews with his axe at the very root of the philosophic side of science. He looks into the minds of scientific philosophers and claims to discover there sources of illusion woven into the structure of the intellect itself. He points out four fundamental assumptions as the byways from the true path into which they tend to turn and lose themselves. These are:

1. "That every concept is the counterpart of a distinct objective reality, and that hence there are as many things, or natural classes of things, as there are concepts or notions.

2. "That the more general or extensive concepts and the realities corresponding to them pre-exist to the less general, more comprehensive concepts and their corresponding realities; and that the latter concepts and realities are derived from the former, either by a successive addition of attributes or properties, or by a process of evolution, the attributes or properties of the former being taken as implications of those of the latter.

3. "That the order of the genesis of concepts is identical with the order of the genesis of things.

4. "That things exist independently of and antecedently to their relations; that all relations are between absolute terms; and that therefore whatever reality belongs to the properties of things is distinct from that of the things themselves." (pp. 137 and 138).

In illustration of the first and second false assumptions he mentions the controversy between the champions of the *corpuscular* and *dynamical* theories of matter. The one side insists upon it that mass or inertia is the counterpart of an ob-

jective reality and as it is one of our most extensive concepts all material being has come therefrom. The other side, reasoning with Faraday asks: "What do we know of the atom apart from its forces?" Since we know nothing of matter save through force, they hold forth the view that force is an entity and from it everything has come. Our author tells us that "force is nothing without mass and mass is nothing without force." (p. 161.) He denies that either is a fact in itself and declares both "conceptual integrants of matter." "In both cases products of abstraction are mistaken for kinds of reality." To clearly understand the exact nature of this controversy requires careful thought. Judge Stallo's view of this warfare between the great thinkers of the world is one which I fear can never become universal. Although it is certain that one or both sides may be wrong, yet it is hard to believe that the object sought after by each and which one side imagines it has found in force and the other in mass is totally delusive. That bodies exist, *as such*, in virtue of their relations is quite conceivable, but to say that they exist "*solely* in virtue of their relations" sounds to me like utter nonsense. That "things are known to us solely through their properties; and the properties of things are nothing else than their interactions and mutual relations" as affecting our consciousness, is quite true.

To tell us that "the annihilation of all bodies but one would not only destroy the motion of this one, as Prof. Neumann sees, but would also destroy its very *existence* and bring it to *naught*," taxes our credulity somewhat. If we believe in the impact theory of attraction we might see in the annihilation of all bodies, save one the perfect solution of that one, but by accepting the counter theory even this difficulty would disappear. Here is the basis of his charge of the fourth metaphysical assumption. Men of science entertain the view that behind such relations as we are cognizant of lies a something so related. What meaning can we attach to the fact of relation unless there is something related? If no one thing exist without the total that one must be the total. On what ground can we claim that a finite total, of any size, is impossible?

Prof. Wm. James, of Cambridge, Mass., in "Mind," April number, 1882, p. 196, in an article entitled "On some Hegelisms," presents the position of our author. He is showing the difference between Hume's Empiricism and Hegel's "Ontological Reveries," (as the judge calls them,) on the principle of totality. "But Hegelism dogmatically denies all this to be possible. In the first place it says there are no intrinsic natures that may change; in the second it says there are no adventitious relations. When the relations of what we call a thing are told, no *caput mortuum* of intrinsicality, no 'nature' is left. *The relations soak up all there is of the thing;* the 'items' of the world are but *foci* of relation with other *foci* of relation. *And all the relations are necessary.* The unity of the world has nothing to do with any 'matrix.' The matrix and the items, each with all, make a unity, simply because each in truth *is* all the rest." Does not this sound very like our author's position? Is it quite certain that the present work is entirely free from the effects of the spell which held him in 1848 when "The Philosophy of Nature" was published?

If we study a piece of matter, say sodium, we find it in possession of certain properties or attributes by virtue of its relations. It has weight, color, affinity, ductility, malleability, inertia, motion, size, etc. Take it away from the earth and the farther we go the less its weight becomes. Put it in the dark and it has no color. Keep it from oxygen and such other substances as it unites with chemically and it has no affinity. Vaporize it and it has no ductility nor malleability. Its size is great or small as it is expanded into steam or contracted to a solid. O r judgment of its motion depends upon a relatively stationary standard from which to compare it. As we now view it scientifically the conditions which give it weight, color, affinity, etc , are conditions of motion. Remove one by one the conditions which give bodies their properties and what is left when every condition has been removed? We perceive no substance *per se*. All manifestations are those of inertia and motion. These are themselves but conditions or relations. The corpuscular theorists, we are told, upon this final analysis, choose mass or inertia, and the dynamical theorists motion or force.

Our author says that bodies come to naught when thus treated. He sees relations only. But relations of what? Here is a house. It has windows, doors, floors, walls, roof, stairs, rooms, etc. All these together form a house. We cannot conceive of any less than walls and ground floor as a house. Suppose two men should contend with each other as to which of these two final terms was really the house. Let a third come in and show them that walls could not stand on nothing for a support and that bare ground was not a house, then we would have a fair illustration of the question. Matter is the house. Inertia is the ground floor. Motion is the walls. A certain set of relations form a house. Relations of what? Matter, of course! Not relations of the last two conditions constituting a house either together as Stallo has it nor apart as those he wars with have it. It is not motion and inertia, motion alone, nor inertia alone. At present it is useless to give it a name other than the unknown. To call it by any term of either matter or motion is as senseless as to call matter in our house relations by the name ground, wall, floor or any other term denoting part of a house.

Our order of symbols fail to describe the real whose relations form matter. Faraday perceives that the real is not motion, hence he speaks of it as force, talks of lines of force and makes a *quasi*-material of it. The antagonistic school speaks of it as inert mass and not mere inertia. Both sides look beyond the attribute to a something, they know not what. They mean the same but do not know it, because their points of view differ materially. This common something Mr. Herbert Spencer calls the unknowable. Nature presents itself to us in all its dimensions only by viewing it from opposite sides. I cannot see all of a chair or table, tree or house, even externally, but by viewing from diametrically opposite points. Inertia and motion are the vanishing points of all objectivity. To objective sense here end our symbols. Physical science must stick to inertia *and* motion because it can go no deeper. Ontology may guess at the unknown beyond but without hope of ever reaching it. Psychology is the only hope and

and it may forever fail. External nature we see mediately through the senses. Sensations are immediate possessions. Only the immediate is real. The mediate is composed of a series of transmutable symbols. A common symbol may change into two or more utterly uncontrastable one, as when we feel a moving tuning-fork and hear a sound. One and the same external condition gave me through different channels two sensations as unlike as a sensation of a spiral motion, (to borrow Tyndall's illustration), is unlike the sensation love. It is just as hard to believe that the sensation vibration and the sensation sound are the same as to believe that the sensation motion and the sensation love are the same. In the first case we have some show of proof, in the second none has been had.

In psychology as in physics two contending schools are struggling for the mastery. Monists claim that chemical changes or rhythms of some sort in brain substance constitute sensation and thought. Dualists declare that mind itself is totally aloof from matter and merely connected to it much as a player is to a piano. Both await the proofs of future investigation and speculation. If Dualism is true there is no hope of our ever being able to acquire any knowledge of what lies beyond the vanishing point of matter. If Monism is true we may never be any better off, but it gives a solitary ray of hope that its disciples will use all effort to brighten as ages roll past. According to the latter doctrine every sensation produces or is produced by some mode of motion. A better way of stating it is, that our immediate and real perception is the sensation, and the mediate, and consequently symbolic, way of perceiving it, is as a mode of motion. It is supposed from what we already know of objective things that if I could look into my neighbor's brain when he is thinking, a definite set of movements would appear, ultra-microscopic perhaps, yet movements. Every time he thinks the same thought, the same movements occur.

Now these movements reach me through ether, optic instruments, nerve-threads and gray matter. Each change alters it. When it reaches me through these mediums it is transmuted just as the vibrations of a tuning-fork are transmuted into sound. As sound in no way resembles a vibrating fork, so vibrating brain matter in no way resembles thought. That which totally altered vibrations and changed them into a musical note, totally altered thought and changed it into the symbol of moving matter. The thought with its constituent sensation was the real mode and substance, the motion with the matter it shook was the illusion. The first must be the real. Thought and sensation are immediate. All subjective sensation is immediate. Objective sensation is always mediately derived and necessarily changed by the transmitting medium or mediums. All we know of nature external to ourselves must necessarily be merely symbolic on this account, *until we discover some method of interpreting our symbols into terms of the real.* Only with the vibrations of brain stuff have we succeeded in making this interpretation. The thought is first visible perhaps as the black characters on a page of paper. These being read aloud, are transmuted into a different set of symbols known as air waves or vibrations, these are finally transmuted into sounds of words and sentences.

Now the magician Mind does his work. He takes hold of these symbolic sounds and interprets them into ideas in thought, and the same thoughts with the same feelings as they started. Here we are able to take hold of the immediate state of objective things by becoming able magically to transmute the symbols into terms of the real. From set to set of totally different symbols it traveled to be at last correctly interpreted. Shall we ever be able to do with our eyes resting on a human brain what we now can do with our ears turned to the human lips? It does not look probable that such a consummation can be ever reached. Yet who dare say "never"?

Brain and vibrations, lips and vibrations are all symbols. Our bodies are masses of symbolic relations. All of animate and inanimate(?) nature is the same. We discover a common symbol in them all. Everywhere our mediate perception gives us matter and motion in time and space A few isolated specks called human brains have only just begun to give us light of what this common symbol means. Sensation looks as if there was a possibility that it gave as its objective symbol inertia, and modes of sensation and thought look as if they gave as theirs, modes of motion. Motion and mass are both mere sense illusions, if this is true, and mind only constitutes the all. Matter and mind cannot even be two sides of a common unity as many persons are pleased to view it. "Death is swallowed up of life." Matter is a mere set of objective relations that are absolutely nothing in themselves only as they stand for thoughts and feelings. What a task is before the psychology of the future? To it is bequeathed the work of reading the subjective meaning, first, of brain movements and finally those of all being. If monism proves false then it surely looks dark for the discovery of what it is whose relations as symbols we know. If we cannot get into things through our symbols we are helpless. From the symbolic without we can gain no steps beyond inertia and motion. The noumena must remain an eternal unknowable.

The Judge's special illustrations of his third metaphysical error of science are first the atomic theory and second gravity. The order of experience with matter in a growing child is first the solid and last the gas. His concepts therefore develop in this order. The true order according to our author is the reverse of this. "All evolution proceeds from the relatively Indeterminate to the relatively Determinate, and from the comparatively Simple to the comparatively Complex." (p. 172) The gas he claims is not only comparatively indeterminate but is also the most simple form of matter. He concludes from this, and probably correctly, that we should seek to explain the solid by the gas, rather than the gas by the solid. If we admit molecules at all they should be soft, expansive and contractile ones rather than hard, inelastic ones. When, however, from this ground he reasons that gravity is action at a distance, his positions are utterly untenable. Gravity so far from being indeterminate is the most determinate form of energy we know and instead of being comparatively simple is so complex that theory after theory has failed in attempting to explain it. His attempt to clear himself from Mill's objections to action at a distance clearly shows the complexity of the problem, even on that assumption. He says: "This inability results from the

inconsistency of this concept with the prevailing notions respecting material presence. If we reverse the proposition that a body acts where it is, and say that *a body is where it acts*, the inconceivability disappears at once." (p. 145).

The sun then is where the earth is and the earth where the sun is. They envelop each other or are parts of one another, we will suppose he means. Now on either assumption how can gravity be conceived unless by some mechanical theory of relations of one to the other or of parts to a whole. With the theory of the continuity of the total we still require to know how gravity causes a body to move. Is the space between two bodies like a piece of elastic rubber but unlike rubber pulling harder the less it is stretched. *If a body is where it acts then there is after all no action at a distance.* He denies impact and yet reduces his own theory to one of impact. He solves the problem by giving it up. By his own showing then he is guilty of the very metaphysical error he charges upon his opponents. But this abuse of the word metaphysical—this casting it about as a term of opprobrium is useless and vicious. What is gained by telling our opponents that they demand "that the first rudimentary and unreasoned impressions of the untutored savage shall stand forever as the basis of all possible science? Did the savage have no correct notions of nature? Were not his experiences and some of his inferences as sound as the best of ours? Why should these not stand forever as the basis of all possible science? Shall we reject a truth because it was so patent that even primitive savages saw it?

There is really no difference between Hobb's statement that "there can be no cause of motion except in a body contiguous and moved," and that of Stallo that "a body is where it acts." It is different ways they have of putting it. Gravity is a property of matter resulting from mutual interaction and relations. Color, sound, size and shape are the same. With one and all what we seek to know is the exact character of the relations which give rise to them. To assert that "all attempts to reduce gravitation or chemical action to mere impact are aimless and absurd," (p. 163,) is in substance to assert that it is an absolute and insoluble fact instead of a condition outwrought by mutual relations. If gravity is produced by relations we want to know what these relations are. As yet no theory of gravity has been propounded that meets all the conditions of the law. Action at a distance is nonsense, as the Judge virtually concedes. Should we see a tug-boat ahead of a ship pulling it, with neither hawser nor chain between them, common sense would reject with contempt an *actio in distans* explanation from any one. When the valve of a pump becomes the means of raising water from a deep well, we explain it by atmospheric pressure in the water below. How much easier it would have been to call it *actio in distans*—the valve attracts the water because it is where it acts or attracts—*i. e.* on the water and the water in it. This would have been a far easier way of disposing of it, although scarcely as conceivable as nature's abhorrence of a vacuum.

That not one only but several theories of gravity might be framed answering to the conditions of the law so far as these conditions are yet known is quite possible. Although such a theory may be of little practical utility and perhaps be

merely a fiction of the imagination, still the presentation of one can do no possible harm and will do some good by tending to keep the distant action philosophers from saying things they may ere long be heartily ashamed of. Mr. Wm. B. Taylor, of Washington, in the Smithsonian Report for 1876, pp. 205 to 282, gives brief descriptions of the Kinetic theories of Newton, Hooke, Villemot, Bernoulli, *Le Sage*, Euler, Herapath, Guyot, Faraday, Sequin, Bouchepom, Lami, Waterson, Challis, Glennie, Keller, Tait, Saigey, Croll, Leray, Boisbaudron, Guthrie and Crookes. None of these answer the conditions. Mr. Taylor resorts to *actio in distans*. On page 211 he gives the six following conditions to which a theory of gravity must correspond or be rejected at once:

1st. "Its *direction* is radial toward the acting mass, or rectilinear—indefinitely. This rectilinear traction is incapable of deflection by any intermediate force. It suffers neither disturbance nor interference from any multiplication of similar lines of action, and admits neither of reflection, refraction, nor of composition.

2. "Its *quantity* is exactly proportional to the acting mass—indefinitely. Corollary: hence, 2b. Its *integrity* of action is complete with every accumulation of additional demand—indefinitely; that is to say, no multiplication of duty in the slightest degree impairs its previous tensions.

3. "Its *intensity* is diminished by recession, in proportion to the square of the distance through which it acts—indefinitely; in a manner somewhat analogous to—but (as modified by the second condition,) radically different from—the action of light.

4. "Its *time of action* is instantaneous throughout all ascertained distances, and therefore presumably—indefinitely. Corollary: hence, 4b. Its *rate of action* (if the expression may be tolerated) is precisely the same on bodies at all velocities—indefinitely. It no more lags on a comet approaching the sun, at the inconceivable speed of 200 miles in one second than on a body at the lowest rate of motion, or than on the same comet receding from the sun at the same velocity.

5. "Its *quality* is invariable under all circumstances—indefinitely. It is entirely unaffected by the interposition of any material screen, whatever its character or extent; or in other words it can neither be checked by any insulator nor retarded by any obstruction.

6. "Its *energy* is unchangeable in time, certainly for the past 2000 years; presumably—indefinitely. Corollary: hence, 6b. Its *activity* is incessant and inexhaustible—indefinitely; the ceaseless fall of planets from their tangential impulses involving no dynamic expenditure in the sun or in other known matter."

True to the mechanical theory the explanation about to be offered begins with atoms. These atoms, however, are very active little things and not at all hard. They were first introduced to the world as probably performing some such function, by Prof. Sir Wm. Thompson, of Glasgow, Scotland. They are the vortex atoms that we heard so much about a few years ago. Helmholtz has shown that vortices in a perfectly frictionless fluid would be eternal. Thompson experiment-

ing with vortices shows that they possess just such qualities as we demand of an atom to have it explain some of the principal properties of matter. When we form vortices in air and make them visible with smoke, it becomes possible for us to see and study their actions. Without the visible smoke they are still there and subject to exactly the same strictures as our author puts upon the hypothetical ones (pp. 43, 44), but ignoring such logic they still swing.

Our frictionless fluid is neither destitute nor incapable of difference. It can have various sizes and shapes of vortices and these are all the differences needed. Relation after relation in time and space can be built up hypothetically among them. Here we have the universal fluid as mass and the vortex as motion. The motion is of the fluid and not of itself. Inertia is potential in every vortex because of the presence of mass. They are in space flying in all directions. By beginning with such a fluid and such atoms we explain the solid by the gas as our author declares we should. But even this is subject to his censure. We have here relations of something and he wishes the relations themselves to be everything. Now such atoms do not gravitate. Let us hypothetically build up from these a gravific molecule. These vortices if supposed to be clashing against each other and rebounding with perfect elasticity will be all that is needed. Preston's modification of LeSage's theory (Phil. Mag. Ser. 5, Vol. 4, pp. 364, 375,) will give us some idea of what would happen under such conditions. We need no such long free paths as he calls for however. They can be comparatively very minute. A number, anywhere from three up, of the largest of our vortices shield each other from the cannonading of myriads of small ones. The shielded faces necessarily rush together. Their elasticity makes them rebound. Back and forth they rush. Natural selection brings from chaos order. Molecules are evolved from rushing atoms in this manner. Myriads of centres of our large atoms are formed having an indefinite permanency because of the orderly rush. We have then molecules that rapidly change from expansion of their substance to contraction of the same in incessant rhythm. Their balanced constraint by the rush of small atoms gives them tangible inertia in every direction. It tends to keep them as a whole in the condition of rest or motion in which they happen to be found.

Such are the gravific molecules demanded by a Kinetic theory of gravity. They are rapidly expanding and contracting pieces whose movements resemble somewhat that of a cosmic system according to the nebular hypothesis, but, while the system requires untold ages to undergo its changes, our molecules pass through theirs in inconceivably minute periods of time. Surrounding these molecules on every side is found the smaller sized atoms in differentiated arrangements totally unknown. These we will suppose constitute the universal ether. Now what would happen to such expanding and contracting molecules pressed in upon every side by walls of rushing ether particles? All those having a common time of change would necessarily be driven together by their own pulsations. Systems of waves would go out from all to all and these waves would be in unison with the molecular beats they came in contact with. A's waves would keep time with

B's rhythms in size and B's waves with A's rhythms. When A is in the crest of B's wave it rapidly expands into the sinus and when in the sinus it contracts into the crest. B does the same by A's wave. What happens? Let a body rapidly expand from a dense toward a rare medium and it will necessarily leap forward toward the rare one. As it contracts in going into the dense one again it does not lose the ground gained. The ether contractions and expansions for waves must of course be of different atoms from the little ones forming the molecule by their rush. We need in other words two ethers, one for undulations and a finer one for the cohesive force of our molecules.

Many known facts in science constrain us to believe in two ethers aside from this theory. When a swimmer turns the narrow part of his hand to the water in his cut stroke and the palm in his back push he does virtually what we imagine our gravific molecules do. When fish with fins and tails and birds with wings propel themselves by presenting a narrow surface forward and a broad one in the back push, they do the same. Our molecules by their movements can go in but one direction and that in an exactly straight line to the source of radiation. Could the first condition of a good theory of gravity be better filled? "Its direction is radical toward the acting mass" As the source of power is in the molecule itself, exactly as you increase the number of such molecules so you will increase the power. It exactly fills the second condition and its corollary. "Its *quantity* is exactly proportional to the acting mass." "No multiplication of duty in the slightest degree impairs its previous tensions." All radiation obeys the law of inverse squares. The crests and sinuses on which the reaction of our molecules depend vary in their power of reaction inversely as the square of the distance from their source. The third condition of the problem here meets a remarkable agreement. "Its intensity is diminished by recession, in proportion to the square of the distance through which it acts." The source of action being in the molecule itself no time whatever is necessary for its manifestation. It is immediate—instantaneous in its power, for all places. On this fourth condition every other kinetic theory hitherto advanced has broken down.

In seeking for the action outside the molecule time was necessary to carry the effects across space. By seeking it within the molecule and giving to all matter a common time of rhythm "its time of action is instantaneous." As the wave determines the acceleration of a falling body "its *rate of action* is precisely the same on bodies at all velocities

Such molecules as we have depicted are kept saturated with energy in relation to each other. No sooner have they by the outward rush upon the ether sent forth waves at the expense of their energy than it is re-supplied. They receive from the minutest of our ether atoms by clash and give to the larger ones by rebound. They absorb no radiant energy that reaches them, but add more to it. A world of such molecules put between a sun and moon of them would be absolutely transparent. It would not abstract a particle from the radiant force but would add to it in exact proportion to its size. Thus is the fifth condition satisfied. "Its quality is invariable under all circumstances." The fact that the

universal ether appears to have no specific heat may be owing to some such condition of things as is here pointed out. The state of things which makes possible the fifth condition, as before explained, gives us also the sixth and last. "Its energy is unchangeable in time. * * * Its activity is incessant and inexhaustible." One difficulty that has beset the undulatory theory of light has been the supposed resistance to planetary motion it would produce. The conditions of our theory of gravity are such that there could not possibly be any resistance to a falling body by its presence for the simple reason that the body could not fall without it. A balloon is not resisted in its rise by the atmosphere. It would not be able to rise without it. The resistance of ether is in a direction opposite to gravity.

This guess at the cause of gravity you will perceive meets one after another of the difficulties hitherto experienced by kinetic theories, but you are not on this account to imagine that the true solution is found. Many a mere fiction has not only answered to known conditions of an order of phenomenal manifestations, as this does, but has also become a successful working hypothesis, which this has not. Such theories if used properly, however, are often excellent scaffolds for the mind to scale upon and build to the true.

In consonance with the philosophic part of this book the author attacks physical science in nearly every one of its great theories. Chemistry and molecular physics suffer the severest at his hands. In the concluding chapter he denies holding the metaphysical belief of the absolute continuity of matter, yet most of the work is taken up with an endeavor to overcome the common idea of its discrete nature. His attack upon hard, inelastic atoms is well timed and sound, but when he from this ground battles Avogadro's Law, Cauchy's finite spaces, Maxwell's kinetic theory of gases and Tyndall's atomic cause of light undulations, it appears as if he stretched his points and made our ignorance do service for knowledge. No living being can frame a theory that will not constantly be seen in new lights with every progress of knowledge. No matter how perfect it may be it is constantly subject to new strains and new explanations because of new and unlooked for relations. Time after time they all must be challenged. It does not therefore follow that if a theory appears to fail at some one point because we have not all the facts, the theory is false. Take the Judge's objections to Avogadro's law for example, and we will see that they are founded entirely on our lack of knowledge of the facts upon which alone a true conclusion can be built. It demands atoms with different qualities, he tells us, while all material atoms, if the foundation of mechanics on which we build is true, should be exactly alike. But these may be evolved articles, we answer. That they cannot be, he says, because of their specific heats. Again, we answer that they may be saturated with energy. Who knows? (Such molecules as we demand for our theory of gravity would completely upset such an objection). We cannot find out. Shall we, therefore, cast aside this law and leave the myriads of facts it has been the means of discovering in utter chaos? False theories have aided prevision to some extent, but only because of the elements of truth attached to them.

A theory that gives prevision in so many directions must be almost or altogether true. Cauchy's explanation of the uneven refraction of all colors of light was a nearer approach to a complete solution of the myriad changes wrung upon waves by varying conditions but as it is strong evidence in favor of the discrete character of matter of course it is objected to. New facts in the case have arisen for explanation. These show that some of us have overestimated the amount of delay in ether and underestimated it in transparent, dense bodies. What of it? Who pretends to have solved the problem of transparency? Is it utterly improbable that the molecules of a piece of glass or of some bisulphide of carbon take part themselves in the undulations going through them? We *know* they delay light far more than ether does.

Give us the finite intervals and attractions in air, glass, and transparent bodies generally and have them conduct light upon their own substance instead of through their pores and the problem is solved. Can Judge Stallo or any other person say that these are not facts in transparency? The Judge says that if sounds of all pitches did not travel in air with equal speed music at a distance could not be heard as such, but would reach our ears as a gamut. Does he not know that with waves of sound as large as we know they are and with molecules of air as small as we know they must be, we would have to hear the music at a practically infinite distance for such a phenomenon to manifest itself? Cauchy has proven that if light is undulatory finite intervals are the conditions upon which the colors of the rain-bow depend. Light must be either undulatory or corpuscular. We know it is not corpuscular. Maxwell's Electro-Magnetic theory though altering our views on some points must nevertheless be undulatory and depend on finite intervals for its explanation of the spectrum.

ASTRONOMY.

HOW TO TELL THE DISTANCE OF THE SUN.—THE TRANSIT OF VENUS, DECEMBER 6, 1882.

EDGAR L. LARKIN.

RUDIMENTARY PRINCIPLES.—If we divide a semi-circle by its radius the quotient will be 3.1415926535. But in a semi-circumference there are:

160 Degrees,	divided by 3.1415926535 =	57.2957795139
10,800 Minutes,	" " " =	3,437.74677
648,000 Seconds,	" " " =	206,264.80625

That is, a radius of any circle contains in terms of the circumference in round numbers 57 degrees, 3437 minutes, or 206,264 seconds. These are among the

most important numbers known to mathematicians, and should be committed to memory by all who would learn astronomy or know how celestial measurements are determined. Let us examine this matter closely Take a ball one foot in diameter, place it on a standard in front of a telescope provided with a micrometer, and the globe will subtend a certain number of degrees angular measurement which, let us assume is four degrees. Now move the standard on a right line away from the telescope, and soon the sphere will only subtend three degrees, then two degrees, until finally its distance becomes so great that its angular diameter shrinks to one degree. An important circumstance follows—we know that the ball is precisely 57.295795139 feet distant from the focus of the objective, because we have seen that radius contain that many circular units. Again, move the standard until the angular diameter of the ball shrinks to one minute, and it is at once known that the globe is distant 3437.-73677 feet. Still bear the sphere away until its diameter subtends one second, a space only visible in a powerful telescope, and we likewise know that the ball is in distance 206,264.80625 feet or 39.0653 miles.

This is the process of measuring the distance of an object when its linear diameter is known. To reverse the case we will suppose that we have a globe whose diameter is one foot placed on a standard. Let an observer with a telescope retire and view the ball at a distance, and telephone to an assistant at the sphere its angular diameter. Then the party at the standard can tell the distance of the telescope. If the message received is:—the apparent diameter is one minute, of course the distance traversed is 3,437 feet, if two minutes half that distance. But to avoid calculation sines, cosines and tangents of all angles are made use of to abridge the work. If we divide:

3.1415926535 by 180 the quotient is .0174532925
3.1415926535 by 10,800 the quotient is .000290888820867
3.1415926535 by 648,000 the quotient is .000004848136811

which decimals are ratios of the units of the circumference in terms of the radius, for degree, minute and second respectively, and are termed sines. To determine distances all that is necessary is to use the sines in simple multiplication and division. Thus the diameter of the ball is one foot, and since the observer saw it as one minute, we divide 1 by .000290888820867 having for a quotient 3437.74677 feet distance.

THE DISTANCE OF THE SUN.

If the Sun subtended an angle of one second we have seen how many times greater its distance would be, than its diameter, but the actual angular diameter of the Sun as obtained by many measures is 1924 seconds. Therefore 296,264.-80625 divided by 1924 equals 107.20624 which we positively know is the number of times the distance of the Sun exceeds its diameter. But this gives us no clue to the distance in miles, because we have not yet learned the diameter of the Sun in miles. We know its angular diameter to be 1924 seconds of arc,

whence it is clear that if the number of miles in one second is known, the diameter of the Sun in miles and its distance can be told by simple arithmetic.

But men have been striving for 2000 years to find the linear value of one second at the Sun's distance. Really it is the greatest problem ever undertaken by the human mind, it has become of world wide importance, while the nations of earth have taken up the question, organizing expeditions to send to the bounds of the world. As we write, every civilized people is making up parties to journey throughout the earth to make accurate measurement of the transit of Venus across the solar disc on December 6th, next.

Forty expeditions are already announced, while those contemplated by the United States, Italy and Austria have not yet been published. France will send out eight fully equipped parties, four south and four north of the Equator. The United States will have six groups of astronomers in the central line of the transit, while all the permanent observatories in the country will make close watch of the phenomenon. The occasion is worthy the combined effort of mankind, because soon as the precise distance of the Sun is known, the dimensions of the universe become known, for the solar distance is the measuring line used by astronomers to let fall in unheard of solitudes of space.

THE TRANSIT OF VENUS.—The sole object in measuring the displacement on the solar disc, of the planet Venus in transit, is to find the number of miles in one second of angular measure at the distance of the Sun.

In other words how large does the earth look if seen by an observer standing on the Sun, and what is its apparent angular diameter. The diameter of the earth in miles is known with great precision, the probable error being within 200 feet. It is self-evident that if it can be ascertained how great an angle the radius of the earth subtends if viewed from the Sun, we shall at once know the value of one second of arc in miles. The method made use of is as follows: Let the line A B be a wall, C and D observers having telescopes, and V a ball resting on a support. Now let C rest his glass on V and he will see it in apparent projection on the wall at B, while D will see V at A.

But the distance from C to D is known, therefore the distance from C and D to V and to the wall can be told in feet providing we know the *relative* distance.

The relative distances between the Sun and planets have been known since the time of Kepler, while the real distance is what men are now searching after

with enthusiasm. The relative distances of the planets from the Sun and from each other, are found by measuring the angles described in a specified time by the exterior planets at times of opposition, and those of interior, by the angles presented at elongations. For two centuries it has been known that if we call the distance from the earth to the Sun 1 that of Venus is .723; then the distance of Venus from the earth is of course .277. Now in the diagram the wall is the Sun, V Venus, C an observatory on one side of the earth and D another on the opposite, near as can be. And it is endeavored to have C and D at the extremities of a diameter of the earth that is perpendicular to the plane of the ecliptic. As the latitude and longitude of C and D are known, the arc of the great circle a circumference of the earth passing through them being interrupted thereby, is known. Having the arc we know its chord in miles, which is none other than the straight line through the earth, joining each station. The first step of each party on arriving at their destination is to find their precise latitude by direct observation on fixed stars. Then the longitude is determined by chronometers in conjunction with transits of fundamental stars. At length the eventful moment arrives, the instruments are all in adjustment, and Venus, a black ball, just cuts off a ray of light from the eastern limb of the Sun. The absolute instant of contact in Greenwich time is noted and recorded, the exact point of ingress on the solar edge measured from the north point is also recorded and the transit progresses. This same observation is made from all the stations, accurate results being saved at each for reference.

The precise time of disappearance of Venus from the western limb is also noted, as well as the exact point of departure. Upon reaching home the results are compared. Those observers who were stationed south of the earth's equator will all bring in reports saying that they saw Venus make ingress and egress at points further north on the solar disc than did those remaining at observatories in north latitude.

Thus—if an astronomer at Washington compares notes with the one who went to Santiago, he will find that the southern observer has record of contacts at points farther toward the north point of the Sun than he has. Since these places of contact are accurately measured, the distance asunder of the chords A and B becomes known in seconds of arc. Venus appears to all observers whether north or south of the equator, to traverse straight lines from east to west across the Sun, but these lines are chords of arcs whose sines are found in any table. But the space between the chords corresponds to a known difference in position of observers on the earth, depending directly on the length of the straight line through the earth connecting any two observing stations. Then:

$$.277 : .723 :: 1 : 2.61.$$

That is, the ratio of the distance of Venus from the earth is to its distance from the Sun as 1 to 2.61. Hence the space between the chords on the Sun is to space between two stations on the earth in the same ratio or as 2.61 is to 1. In other words the distance apart of the chords is 2.61 times greater than the

diameter of the earth. What we are searching for is the meaning equatorial horizontal parallax of the Sun, or what is the same thing, the angle that would be subtended by the mean equatorial radius of the earth if viewed by a micrometer placed on the Sun. Radii drawn from all the observing stations to the centre of the earth of course are not equatorial, since observers are placed in all latitudes, hence they must be expressed in terms of equatorial radii by computation.

Again, the mean distance of the earth from the Sun is equal to 1, but at the time of the last transit, December 9, 1874, and at the next December 6, 1882, the earth was not, and will not be at mean distance; being near perihelion, with distance less than unity. And due allowance must be made for this fact in calculating parallax, also an allowance must be noted arising from the motions of the earth and Venus during the time of transit, which complicate matters, making it necessary to introduce algebraic formulas wholly inconsistent with a note like this, only intended to give general ideas. However, when all corrections are made, it is found that at transits of Venus under refined micrometrical manipulation, the space between the chords on the solar disc corresponding to a distance on the earth equal to its mean equatorial radius, is 22.96 seconds of arc. But we have seen that this is 2.61 times greater than the line that would be subtended by the semi-diameter of the earth at the same distance. Whence 22.96 divided by 2.16 equals 8.8 seconds, the long sought number, the *parallax* of the *Sun.* That is if we stand on the Sun and look this way with a powerful telescope and micrometer, the earth will appear as a little ball whose radius subtends an angle of only 8.8 seconds.

Now since the mean equatorial radius of the earth is known to be 3962.72 miles we are nearing the end of a search kept up for centuries, and will soon know the value of 1 second in miles, at the earth's distance from the Sun. Dividing 3962 72 by 8.8 gives a quotient of 450.30909 the number of miles in one second of arc subtended on the circumference of a circle whose radius is the distance separating the earth and Sun.

But we saw that the sine of 1 second is .000004848136 81, which multiplied by 8.8 equals .000042663603928 the sine of 8.8 seconds, since the sines of minute arcs vary directly with the arcs themselves.

In any triangle the sides are in the ratio of the sines of opposite angles; therefore 3962.72 divided by .000042663603928 equals 92,882,917 the number of miles from the centre of the earth to the centre of the Sun. Or the result may be thus obtained: 1 divided by 000042663603928 equals 23,439.18253337 which is the number of times the distance of the Sun is greater than the mean equatorial semi-diameter of the earth, and being multiplied by 3962.72 gives 92,882,917, as before. If this is not clear to beginners, the case may be presented in a still more elementary form. For when we know the value of 1 second, the circumference can be found by multiplying the value by the number of seconds in a circle. Thus: 450.30909 multiplied by 1,296,000 equals 583,600,580 miles in the orbit of the earth which divided by 6.283185307 the ratio of a circumference to its radius gives as in other methods,—92,882,917.

It may be asked, since we know the distance of the sun, why send expeditions to observe the coming transit. The answer is the precise parallax is not known, it being still uncertain within a few hundredths of a second. We do not know whether it is 8.79, 8.8 or 8.81 seconds. The rays of the Sun heat the atmosphere of the earth and produce a tremulous motion in the focus of a telescope just where the micrometer is, and another trouble is that Venus has an atmosphere which refracts a ray of light somewhat rendering uncertain the exact instant of contact with the solar limb. And it is to determine these corrections to the last transit, and also to verify the measures of 1874 with improved instruments that so much time, labor and skill are to be expended. And there is also a higher aim than this, and that is to leave to future astronomers who will behold the next transit, June 8, 2004, all the data possible for the mathematically exact determination of the great problem.

One method of observing the transit is to photograph Venus while on the Sun and then make computation at leisure; a method radically different from that of measuring directly with a micrometer at the time of transit.

A brisk controversy is now being held by astronomers as to which plan has the least objections, the apparent majority as the case now stands being opposed to photography. The British photographic results were conflicting in 1874, the deductions being, Airy 8.79, Tupman 8.81 and Stone 8.88. Other values deduced by direct measures range from 8.78 to 8 84 seconds. From a careful comp rison of all available records of the problem the writer is convinced that the parallax of the Sun is 8.8 seconds.

There are a number of ways of determining this constant in nature without resorting to transits of Venus, the most important being based on the velocity of light and the law of gravity. And these confirm the best results of transits in placing the parallax at 8.8.

This is the most valuable number known to man, since it enables him to measure the distances, diameters, volumes, weights and densities of all bodies in the solar system; and when he has weighed all these, to soar away into the infinitude of space and weigh other suns than ours and tell their distances.

In conclusion we will endeavor to show with what refinement measurement is expected to be made next December.

Thus: by taking the parallax to be 8.8 seconds, the distance of the Sun becomes 92,882,917 miles. Now if we assume it to be 8.81 then the Sun's distance will be 92,777,488 miles or 105,429 miles nearer, that is a hundredth of a second of parallax equals 105,429 miles in the length of a line reaching from the earth to the Sun. But the hundredth of a second is the equivalent to the angle subtended by the diameter of a hair placed at a distance of 800 feet. Young, The Sun, p. 23.

The observers must have micrometers delicate enough to measure these excessively minute distances with precision, or we shall not derive benefit from the transit. However, the Clarks with their elegant telescopes and micrometers will prove equal to the occasion. Such precision would not be necessary were it not

for the fact that the distance to the Sun is the line that is made use of to measure all others in celestial space. And even an error of 100,000 miles would not be of such moment if we used the solar distance but once in a calculation. But in most physical researches, it is involved in the ratio of its cube. Thus, if we raise for instance, 3 to its cube we have 27, but if we raise 3.25 to a cube the product is 34.328 an error far too large to be admitted. It is seen then that the minute error of 100,000 miles when cubed becomes formidable.

Thus, we cannot tell the distance of Jupiter, nor its weight, size or density, unless we know just how far it is from the earth to the Sun. Kepler's third Law says: that, the squares of the times of revolution of all the planets are in the ratio of the cubes of their mean distances from the Sun. We can all see how long it takes Jupiter to go around the Sun; then all we have to do is to square this time and extract the cube root, and we have its mean distance. Thus: the earth revolves around the Sun in a time equal to 1; and we observe that Jupiter makes circuit in a period equal to 11.86. The square of 11.86 is 140.66 whose cube root is 5.203, hence we are assured that whatever is the distance of the earth from the Sun, that of Jupiter is 5.203 times greater. Knowing its distance, its mass and volume are revealed by the law of attraction.

It is well then that observers equipped by the Nations of the earth engage in this the most sublime of problems. The transit will begin on December 6th at 8:40 A. M. and pass off at 3:14 P. M. Washington mean time. We have no longitude of Kansas City but making a guess from an ordinary map conclude that it is 18 degrees or 1 hour and 12 minutes from Washington, hence the transit will begin there at 7:28 A. M. the Sun rising at 7:02. This observatory is in preparation to observe the phenomenon. Anybody can see Venus on the Sun with a smoked glass.

NEW WINDSOR (ILLINOIS) OBSERVATORY, July 17, 1882.

METEOROLOGY.

THE CYCLONE AT BROWNSVILLE, MO., APRIL 18, 1882.

W. H. WILLIAMS.

The terrible agent of destruction which visited Brownsville on the afternoon of the memorable day above named was, perhaps, in some respects, the most peculiar of any one of its kind ever seen or felt by the people in this latitude.

During the entire day clouds were seen in all directions in the sky; but they were only light, fragmentary ones, the feathery appearance of which did not attract more than a glance. It was not until 3:45 that the overcast of the heavens began to signal the approach of a storm of great violence.

At that hour the whole surrounding atmosphere began to assume a dull, heavy color and then change to an orange tint, very unnatural and peculiar. For a few moments all objects appeared as if seen through stained glass. Toward the southwest a very dark, heavy, green looking cloud was seen rising just above the tree tops. This cloud was compact in shape, solid in surface and seemed to overspread about two or three hundred acres of land.

The outer edges appeared to be thin and vapory, while the space below the cloud was filled with a kind of light, waving substance, resembling a morning mist. This was constantly in motion, and as the cloud moved toward us this stringy, root-like mass of mist was whirling and twirling in rows about as wide as the compact surface of the cloud. This singular tube like formation and motion was what first created in our mind the alarming impression that the dreaded cyclone was approaching us. The phenomenon was more like water running through glass tubes, than anything to which we can compare it.

It was truly a beautiful sight; yet, no artist could in safety to his life, stop long to study its beautiful conformation. From the center of this collection of revolving streamers there came a balloon-shaped, green-looking cloud, or rather crooked, smoky column, which extended about one hundred feet in the air—this is the cyclone proper.

It kept constantly changing its position, motion and shape; at no time did it look the same as at another; sometimes funnel-shaped, larger at the top, then inverted and larger at the bottom. It came wriggling, jumping, whirling and twisting like a great, green snake, darting out a score of glistening fangs. These antennæ-shaped things were bright and clear, but in a few moments went out of sight behind the enveloping clouds, which were struggling to embrace the cyclone. There had been very little lightning and only a few low rumblings of thunder. Scarcely enough rain fell, from first to last, to lay the dust, and no rain at all during the cyclone. The cyclone was right on us before we noticed any unusual force of wind. The wind had been blowing as much from one point as another. When this cloud had come out clearly to view and transformed itself, as we have related, another cloud, not so large and in no way, save color, like the first, was seen moving from a point far south of west.

The two were approaching with astonishing rapidity. Presently they seemed to be converging, and in a few minutes they met. Before they met the lightning played from the back of one to the other, like fiery serpents. After they met all definite shape was lost. The color of the whole mass was a little darker, and all the clouds and parts of clouds were jumbled up together, and rolling and boiling around in the sky. In a few moments two of the most vivid flashes of lightning I ever beheld descended from mid-sky to the earth. These strokes were about one hundred yards apart, and were simultaneous.

Not until those strokes did the terrible roaring of the cyclone commence. There had been from the first a low rumbling and muttering, but no well-defined roar. This increased for perhaps one and one-half minutes, until it was a deafening sound, something that made by freight trains crossing bridges, only

a little sharper. The wind began then to blow very hard, and from the west, but nothing very firm was moved until the cyclone had spun and buzzed over the hill to the southwest of the town, and all at once, whirling and bounding, sprang into the midst of the streets.

After it had passed over and through the streets, indeed, before force of it reached us, and while it was in the midst of the buildings, there was a still darker and greener-colored atmosphere lit up continually by tinges of orange and gleams of red.

Many can testify to the singular appearance of the light emitted from beneath, above and from within the folds of the cyclone.

Houses and fences were not blown down, it is true; some of them were, but in general they were drawn up and twisted around, and then fell back on their foundations. There was not much evidence of any great force of straight wind; only here and there were objects found pointing the same way. As much debris was found thrown in one direction as another.

The path of the cyclone was nearly northeast, and was about two hundred yards wide.

When within one mile of Brownsville it came in a zig-zag course, but before that its main course was northeast, and this direction it kept up until it was scattered. The time of its passage over the city was, perhaps, three-quarters of a minute or more. Its velocity in coming from Montrose to Brownsville—a distance of sixty-two miles—was one and eleven-twentieth miles per minute. Brick houses were seen to rise two feet from the ground and then fall back on their stone foundations, scattering the debris in all directions.

Houses were found twisted at opposite points, strong fences were drawn down in shape of square and triangles; boards, posts, gates, scantlings and stringers were found hundreds of yards off, thrown at all possible angles.

Hardware stores, blacksmith shops, plow-rooms and display houses, were totally demolished, showing no signs of being blown. A safe belonging to George W. Smith was found some forty or fifty feet from where it stood in his office. There were strong currents of attraction towards this cyclone.

Places were found where trees one and on-half feet in diameter were drawn out of the ground, roots and all, while not ten feet away frame shanties remained standing. Scantlings and fence-rails, after whirling around in the air, were thrown off at a tangent and flew like darts through frame buildings, and in some places were found sticking to the depth of two feet in the ground. A flock of geese was drawn up into the cyclone, whirled around, and picked clean of feathers, then scattered in pieces almost everywhere. Plank, grass, shingles, brick bats, dust, feathers, branches of trees, bark, fence-rails, animals, etc., were seen whirling and twisting in the air above the cyclone, as it came down Blackwater and passed over us. In some places large trees were peeled from top to bottom. The cyclone was seen to jump and spin around on the prairies near Brownsville, then rise, whirling and rolling in the air, throwing out those glistening tongues, and coming down again hundreds of yards off.

Wherever it bounded on the ground nothing remained intact. Such are some of the peculiarities of this cyclone.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

Below will be found tabular results of observations:

TEMPERATURE OF THE AIR.	June 21st to July 1st.	July 1st to 10th.	July 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	70.5	66.8	58 1	65.1
Max	90.3	84.0	80.8	81.7
Min. and Max	80.4	75.4	69 1	75.0
Range	20.	21.7	22 8	21.5
TRI-DAILY OBSERVATIONS.				
7 a. m.	77.8	70.2	66.1	71 4
2 p. m.	90.3	85.2	73.7	83.1
9 p. m.	77.7	75.0	69.0	73.9
Mean	80.9	76.8	68.1	75.3
RELATIVE HUMIDITY.				
7. a m.	.87	.86	.80	.84
2 p. m.	.66	.57	.63	.62
9 p. m.	.87	.76	.77	.80
Mean	.80	.78	.73	.75
PRESSURE AS OBSERVED.				
7 a. m.	28.93	28.91	29.09	28.98
2 p. m.	28.90	28.92	29.05	28 96
9 p. m.	28.91	28.87	29 14	28.97
Mean	28.91	28.90	29.09	28.97
MILES PER HOUR OF WIND.				
7 a. m.	. .	. .	7.8	. .
2 p. m.	. .	. .	14.0	. .
9 p. m.	. .	. .	8.8	. .
Total miles	. .	. .	2715	. .
CLOUDING BY TENTHS.				
7 a. m.	4.0	5.4	3.9	4.3
2 p. m.	4.3	2.2	4.7	3.7
9 p. m.	3.0	1.7	3.8	2.8
RAIN.				
Inches	——	.40	2.64	3 04

The report here furnished may be divided into two distinct periods as regards temperature. The hot, dry weather continued till July 4th, no rain having fallen in the last decade of June and the temperature reached its highest point, 95° on July 3rd.

The tornadoes which caused such destruction in Iowa did no marked damage at this station. On the night of June 17th, at about midnight, a violent gale struck Topeka and blew off our anemometer cups before any good record had been left of its velocity. Another storm struck us a little after noon July 11th, and for more than ten minutes the velocity of the wind was seventy-two miles

per hour. At 6 P. M. the same day the rain fell in torrents, and many of the storms have been accompanied by vivid lightning and heavy thunder.

The lowest temperature was 50°, on the 13th.

Highest barometer on the 20th inst. 29.222; corrected for temperature and elevation, 30.178. Lowest barometer on the 7th inst. 28.750; corrected for temperature and elevation, 29.659.

On the evening of the 5th, at 9:30, a very brilliant meteor fell in the west, starting from about the tail of Leo and moving vertically toward the horizon. It was ten times the size of Jupiter and burned with a greenish-yellow light and with a luminous train.

There was a remarkable rainbow on the 15th, lasting from half an hour before sunset till several minutes after the Sun was below our horizon. Both primary and secondary bows were visible and presented a magnificent spectacle on the ground of dark clouds from the retreating storm.

CORRESPONDENCE.

MOLECULES FROM THE DENVER MINING EXPOSITION.

MRS FLORA ELLICE STEVENS.

By the time this number of the REVIEW is published, the National Mining and Industrial Exposition will have been opened at Denver to the world, and that brave, bragging and bonanza young city have arrived at the utmost pitch of delight.

And I do not greatly blame her, she has a right royal reason for being insanely ecstatic. I have always "laid that flattering unction to my soul," that I had every faith in Denver's and Colorado's possibilities and capabilities, but I confess I was most unprepared for the magnificent, massive buildings erected for the exhibition, and the comprehensive plan upon which this is to be worked. The brain and the purse have found here one of those rare occasions in which they may labor in sympathetic and perfect fellowship; as to the results achieved if questioned I give the laconic answer, "come and see." We have a right to a large amount of pride in this wonderful West of ours, when the youngest State in the Union will not merely conceive the idea of a National Mining and Industrial Exposition, but put it into such execution that one will only blush through pardonable pleasure.

The money for the buildings has been entirely subscribed by Colorado citizens; so let us see what these are like, and we shall know how to gauge the liberality displayed. The main hall is 500 feet long, and 310 feet wide, with four wings, each 210 feet square. It is of brick of the very best character. A magnifi-

cent dome surmounts the centre of the building, while two graceful towers finish each wing. Within, the sides are fairly honey-combed with galleries, but the main space of the ground floor is left free for the exhibit of ores and machinery. The buildings have cost $300,000, and an annex is now in process of erection for the agricultural exhibit. This is the "stuff" western men are made of.

The grounds devoted to the exposition consist of forty acres at the southern terminus of Broadway, Denver's most fashionable driving street; a smooth, level and wide thoroughfare leading all the way from the city out to the grounds, which have a lovely view to the west, of the Rocky Mountains, whose foot-hills are but fifteen miles away. A narrow-gauge railway, with easy, delightful coaches runs from Curtis Street—in the heart of the city—to the grounds, and one can go there for the "widow's mite" of our times—a nickel. Both the Denver and New Orleans, and the Denver and Rio Grande Railroads run near the Exposition place, so that the traveller from the east, if he comes up the southern way, has a comprehensive sweeping view of the whole structure before he has fairly entered the city.

With so much said in regard to the breadth and enterprise of spirit which has conceived the idea of and completed the erection of buildings which would be noticeable anywhere on the continent, but which are absolutely wonderful in this the newest of the States, one's attention is naturally called to the causes which led to the exhibition, and the character of the exhibits.

The principal cause for this movement, I gather from the circular issued by the executive committee, to have been a desire to remove the ignorance concerning the resources of the western country, that yet prevails to a considerable extent in the east; to stimulate invention, and bring capital more directly than it possibly has been face to face with opportunities for investment, and with skilled labor in the several provinces of industry to which the exhibition will be devoted.

The area of the Western territory directly interested in mining aggregates 1,196,084 square miles, almost one-third the area of the whole United States, together with Alaska; therefore it is pertinent that mining, its ores and machinery, and the sciences directly connected with it, hold the primary place in the exhibits.

Nothing perhaps will be of greater interest than the immense masses of ores to be exhibited. The largest single mass will come from Arizona; it is of native silver, and weighs seven tons. A mass of soda will be sent from Wyoming, weighing five tons, which will be even greater than the one shown from the same mine at the Centennial. A silver specimen of 2500 pounds, comes from Pitkin, Colorado, and three lumps from San Juan county, Colorado, will average the same. A gold cube also will come from a Pitkin County mine, worth $150,000. New Mexico will send several "chunks" of silver ore of 2,500 pounds; while from the Wood River district of Idaho, probably a dozen will be shipped, averaging 1,000 pounds. The Robert E. Lee, of Leadville, will place on exhibition a mass of horn silver of 166 pounds, which is a great curiosity aside from its intrinsic value. The Horn Silver mine of Frisco, Utah, will also furnish an immense mass, but

its definite size is not yet ascertained. The cost of getting out of the mine of a single mass to be exhibited from Gunnison county, Colorado, will be $500.

It must be borne in mind too, that these are merely samples, selected to give an idea of the ore to be shown in bulk, and they are but a small part of the great and interesting masses to be seen at the buildings during the next two months.

California will exhibit a great many specimens of gold ores; copper and silver will come from the new discoveries of the Corriza mines near El Paso, Texas; Utah has en route three car loads of mineral exhibits; Gunnison county, Colorado, will send specimens of anthracite coal equal to any in Pennsylvania, and the same county has for exhibition some very fine specimens of marble. Wyoming will do her "level best" with a copper display.

Exhibits too are promised from all the mineral producing Eastern States. Indeed, so wide is the interest excited in the scheme, that thirty states and territories, and it may be even more, will be represented either by their ores, their agriculture, or their manufactures.

In Power hall there will be three lines of shaftings, one for light machinery $2\frac{7}{16}$ inches in diameter, with 150 revolutions per minute; the others $2\frac{15}{16}$ inches in diameter, with 200 revolutions. For the machinery exhibited will be in active operation, so that a person may learn here in three days more of the practical workings of a mine, reduction of ore, etc., than he would gain perhaps in going about among them for a month.

Quartz mills, air compressors, drills, retorts, reverberatory roasting furnaces, reverberatory smelting furnaces, pans and settlers for amalgamating, concentrators, etc., all in active operation, will be in the hall; in fact everything necessary to convert the ore into bullion, whether it be of the free or refractory character.

Choice specimens, in cases, of a geological, metallurgical or other scientific nature are promised, and many at the time of writing have already arrived from some of the most eminent scientists in the country, and will form one of the valuable features of the display.

The agricultural exhibit will consist principally of contributions from the western states and territories, and will no doubt be worthy of the rest of the exposition.

The Fine Art gallery is one-third of a mile in extent. It is under the charge of the president of the Denver Art School, himself an artist, an excellent critic and one of the best engravers in the country, J. Harrison Mills. Applications for space here have been made from the leading artists of the United States, while a number of pictures will come from abroad. Keramics will be liberally considered in this department, the Cincinnati and other schools furnishing fine contributions, Miss Louise McLaughlin and other eminent designs also to be represented. So that this department is not to be lightly considered, but promises to be one of interest and beauty, much beyond all that it had been imagined possible to gather together so far west.

The industrial exhibit will have the character of all such exhibitions, with perhaps a leaning to machinery and implements used in mining. Space has

been secured for hundreds of rare, useful and costly manufactured articles, of which one could not give half the names, or they would fill the pages of this magazine.

It is not a scientific fact, nor an industrial fact, nor an agricultural fact, unless we may be permitted a pun, and count it as an attraction hard to *beet* that President Arthur, the Marquis of Lorne and Princess Louise, and a host of other notables are coming; and I hope many readers of the REVIEW, who will see that we have reason to be properly ecstatic.

BOOK NOTICES.

KNIGHT'S NEW MECHANICAL DICTIONARY; Edward H. Knight, A. M., LL. D. In four parts, 240 pages each; 2,500 illustrations. Houghton, Mifflin & Co., Boston. $2.00 for each part.

This is intended as a supplement to Knight's American Mechanical Dictionary, published five years ago, which was pronounced by all the students of technology or mechanics the most perfect work of the kind ever issued, and covers the period from 1877 to 1882. During this period the progress made in the development of the mechanic arts is unprecedented in the history of the world. Not only in such striking and wonderful achievements as relate to the telephone, phonograph and electric light, toward which popular attention is naturally drawn, but in every department of applied mechanics, there has been developed a fertility of resource in the adaptation of means to ends quite as marvelous and equally important in practical results. Achievement has outrun the most sanguine expectation, and with such rapidity that even the most recent records are found to be very deficient in supplying the special information most desired.

The two great exhibitions, at Philadelphia and Paris, with each of which the author was officially connected as delegate or commissioner, and as a member of the respective juries, have brought forward a world of new matter; and the records of our own patent office, as well as the testimony of our technical journals, bear witness to the fact that at no period has invention been more fertile, more brilliant, or more important.

This fact and the success that the former volumes met with in all parts of the world, has induced the publishers to issue another volume, thus continuing the record from the date at which the former work went to press, but carefully avoiding repetition, and aiming to furnish not only a satisfactory supplement to the original work, but a book which shall have an individual and separate value as a complete record of half a decade in the history of invention. From this fact it is evident that this volume forms an indispensable supplement to all works of

reference upon mechanics now extant, as none of them cover the period mentioned.

The description of tools, instruments, mechanics, processes, engineering devices, etc., are full and exact, more so than ordinary, from the fact that the author was formerly an examiner in the U. S. Patent Office, and thus acquired a critical habit of looking into the mechanism and merits of devices presented for patenting.

The same method has been adopted in dealing with the subject matter in both works. First, each article appears in its proper alphabetical place, thus fulfilling the function of a dictionary in affording direct response to inquiry. Second, the items of information thus distributed throughout the work are classified in special indexes of the art, profession, or manufacture to which they pertain. The book thus fulfills the function of a Cyclopædia, which is a collection of treatises.

"An index to a dictionary" may seem a novelty or even a superfluity to the reader of this notice, but when he comes to examine this work he will find that the value of a work of reference depends largely upon its index Doctor Knight has invented a system of what he terms "Specific Indexes," by the use of which the inquirer is guided straight to the information he is in quest of, even though he may be entirely ignorant of the name of a thing, and have but the most vague and general notion of its use. This is accomplished by grouping under the general title of each Science, Art, Trade or Profession a list or "Specific Index" of every article in the book bearing any relation to the subject in question. The titles of these Indexes are in turn grouped at the beginning of the book, so that by a glance one may determine which clew to follow.

Besides the use above mentioned, these Specific Indexes afford the reader an excellent opportunity for investigating thoroughly all that pertains directly or indirectly to any special subject, by using the index under the title of that subject as a sort of starting point, and following out its various branches through all their ramifications.

Special attention is called to a new and valuable feature in the work, by means of which exhaustive information upon any subject is placed within easy reach. The author has made a complete Index to Technical Literature, covering a period of five years, and embracing all English and American technical journals published from 1876 to 1880 inclusive. Under title of each subject may be found a complete list of every article which has apppeared during this period in the columns of these periodicals, and as every subject of importance has been thoroughly discussed therein, it is evident that the whole range of recent investigation is placed at easy command. This Index cannot fail to meet with the heartiest appreciation among those who have experienced the labor and difficulty attending an exhaustive search upon any line of inquiry.

The work treats of many thousand subjects, and is illustrated with over 2,500 carefully prepared engravings and numerous full-page plates, and for general typographical excellence, quality of paper and printing it is unsurpassed. It

may be bound uniform with any edition of the Knight's American Mechanical Dictionery, or with any Cyclopædia or other book of reference of the usual size and shape. Sold only by subscription in four sections, containing 240 pages each.

ORIENT SUNBEAMS, or FROM THE PORTE TO THE PYRAMIDS; by Samuel S. Cox, 12 mo pp. 407, G. P. Putnam's Sons, New York, 1882. For sale by M. H. Dickinson, $2.00.

All of Mr. Cox's books are readable and instructive, combining humor and solid information to an unusual degree, though, perhaps, not remarkable for either quality. He has been a considerable traveler and has had many years of literary experience, so that his volumes hit the average taste very happily; much more so than those written solely to amuse or only to inform the reader.

From his earlier life, when he acquired the *soubriquet* of "Sunset" from an exceedingly glowing and fervent description of an evening sky in a daily paper, where such articles were phenomenal, to the present time he has had a kind of Persian tendency to sun-worship, as the titles of his books, "Winter Sunbeams," "Arctic Sunbeams," "Orient Sunbeams" show. The present volume is a companion volume to "Arctic Sunbeams," and is, in fact, a continuation of his account of the same trip, beginning at the Bosphorus, where the other left him, and describing his journey "from the Porte to the Pyramids, by way of Palestine." To use the words of the author, it takes the reader through the holy places of Mohammedan, Hebrew and Christian to that land of old renown, Egypt. It indulges in observations upon the present condition of the empire of Othman and its principal and most interesting dependencies. Within this shining crescent of travel, Ephesus, Damascus and Jerusalem are, of course, included. All this is done in a skillful, piquant manner, and many of the scenes described are handsomely illustrated.

CELEBRATED AMERICAN CAVERNS; by Horace C. Hovey, with maps and illustrations. Octavo, pp, 228. Robert Clarke & Co., Cincinnati, 1882. $2.00.

This volume will carry with it some additional interest to many of the older residents of Kansas City from the fact that the author, Rev. Mr. Hovey, formerly lived and preached here, but aside from any such local effect it will be received with enthusiasm by all who take an interest in the wonders of nature. For years past Mr. Hovey has devoted his leisure time to exploring the great American caves of Kentucky, Indiana, Virginia and New York, and the pages of *Scribner, Harper's Monthly* the *Scientific American*, &c., have been illumined (so to speak), with numerous articles on the Mammoth, Wyandotte and Luray caves from his graphic pen.

This handsome volume contains not only the most complete descriptions of all of these that we have ever seen, but also of numerous other caverns in the

United States, together with chapters upon the structure, varieties and contents of caverns, followed by a condensed account of cave dwellings, sepulchers and temples all over the world. The illustrations are excellent, and the book is certain of an extensive sale.

THE GREAT PYRAMID; by S. H. Ford, D. D., L.L. D. 12mo. pp. 208, St. Louis, 1882.

The great pyramid of Ghizeh has, from the days of Herodotus to the present time, furni hed matter of interest for travelers, poets, astronomers, architects, divines, archæologists and engineeers. In modern times many attempts have been made to give the dimensions, attitude, openings, internal arrangements, and even the geographical position of the Great Pyramid, peculiar symbolical meanings, though Birch, who is regarded as the greatest of living English Egyptologers, says that "these ideas do not appear to have entered into the minds of the constructors of the pyramids," and Rawlinson thinks that their builders "employed the measures known to them for their symmetrical construction, but had no theories as to measure itself and sloped their passages at such angles as were most convenient, without any thought of the part of the heavens whereto they would happen to point."

Dr. Ford, however, has given the subject a vast deal of study, and is entitled to the credit of having, at least, worked out an ingenious theory and of supporting it with earnestness and plausibility. In addition to the astronomical and chronological facts indicated by various external and internal measurements, he believes and essays to prove that the designers of this especial pyramid were divinely guided to erect a structure which in every part symbolizes some great feature in the Christian religion. Whether we admit his conclusions or not, we cannot fail to be impressed with his earnestness, the logical bearings of the facts and arguments he adduces, and the fitting adaptiveness of the scriptural quotations and illustrations that he brings forward. Scarcely any reader who examines with any care his facts, biblical comparisons, etc., will fail to partake of his enthusiasm. The work is embellished with numerous illustrations, and is appropriately dedicated to the author's wife, Mrs. Sallie Rochester Ford, who has been intimately associated with the Doctor in all his investigations of the subject.

ADVENTURES IN THE FAR WEST AND LIFE AMONG THE MORMONS. By Mrs. C. V. Waite; 12mo. pp. 311. C. V. Waite & Co., Chicago: 1882. $1.00.

This is a narrative of actual experience in crossing the plains in 1862, when it required a whole season to accomplish it, and of life among the Mormons for a number of years. Mrs. Waite is a careful and accurate observer and wields a skillful pen. Her book is attractively written and at the same time gives a great deal of information in regard to the Mormon habits, customs, rules of life, religious rites, etc., that is not readily found elsewhere. The chapters upon Mormon Mysteries, The History of Woman, An Inside View of the Peculiar Institution and The

Secret Orders, are especially rich in this respect. Mrs. Waite is the wife of the author of "A History of the Christian Religion to A. D. 200," that has attracted a great deal of attention, and is a writer of taste besides possessing keen powers of observation.

THE PRESENT RELIGIOUS CRISIS. By Augustus Blauvelt; 12mo. pp. 196. G. P. Putnam's Sons, New York. $1.00.

A graduate of Rutgers College at New Brunswick, N. J., and of Hertzog Theological Seminary, connected with the same institution, the author of this book took up the study of the Bible for the purpose of vindicating the traditional Protestant conceptions about it and religion against all the assaults of modern unbelievers. Unfortunately he undertook to do this by merely invoking ordinary evidence and reasoning, and the result was thus: "He has come more and more distinctly to perceive that the traditional Protestant conceptions about both the Bible and religion, instead of being scientifically defensible even down to details, require a revision and restatement of the most revolutionary nature." These he attempts in the present volume, which is but the first of a series, the second of which will be called the "Religion of the Jesus," and the third "Supernatural Religion." How well he may succeed is for the reader to judge. For our part we neither like the tone of the writers, his manner of stating his case nor his line of argument, although he makes a show of exceeding liberality and draws largely upon other writer for his facts and illustrations.

OTHER PUBLICATIONS RECEIVED.

THE ELEMENTS OF FORESTRY, by Franklin B. Hough, Ph. D. Kin and Clan, a lecture before the Historical Society of New Mexico, by Prof. A. E. Bandelier. The *Record*, a monthly magazine devoted to classical literature and historical criticism, C. V. Waite & Co., Chicago, Ill. The *Grain Cleaner*, monthly, Clifford F. Hall, Moline Ill., Vol. V, No. 5. The Isthmian Canal, by L. U. Reavis, with an introductory letter by Capt. Silas Bent, St. Louis, Mo. First Annual Report of the Committee of the Archæological Institute of America, on the American School of Classical Studies at Athens. Notes on the Habits of Some Western Snakes, by H. A. Brous, M. A , M. D. The *Journal of Comparative Medicine and Surgery*, a quarterly journal of the anatomy, pathology and therapeutics of the lower animals, Vol. III, No. 3, W. L. Hyde & Co., New York, $2.00. Natural History of Pettis County, Mo., pp. 19, by F. A. Sampson, Sedalia, Mo. General Notes on Anthropology, Prof. Otis T. Mason. A Science Based on Assumptions, pp. 16, Hon. W. D. Kelley. Second Annual Report of the Astronomer in charge of the Horological and Thermometric Bureaus in the Observatory at Yale College, 1881–82, by Leonard Waldo.

SCIENTIFIC MISCELLANY.

SOME RECENT IMPROVEMENTS IN THE MECHANIC ARTS.

BY F. B. BROCK, WASHINGTON, D. C.

NOVEL REVERSIBLE WINDOW.—A recent invention provides a window, the sash of which slides up and down in the usual way with counterweights passing over pulleys A portion of the length of the window jambs is a pivoted swinging frame, so that both sashes may be run up into the frame, and swing out horizontally or reversed, as desired. The swinging frames are mounted on hol low pivots provided with cross-pintles and rollers, over which the sash-cords pass. A spring catch in one of the side frames, operated by a lug on a rod, engages a notch in the sashes. The cords have an apertured plate to prevent twisting. The swinging frames are grooved to receive the sashes.

FIRE-PROOF CURTAIN FOR THEATRES.—A recent German invention has been gotten up by Herr Von Falkenhausen, for separating the stage from the auditorium in theatres in the event of the breaking out of a fire. The curtain, which is closed at the sides and open at the bottom, is secured at the upper end to a perforated water-pipe. The other end is rolled upon a roller stationed above and in front of the water pipe, so that when the water is turned on the weight of the wet curtain nearest the water-pipe will tend to unroll the curtain until it falls down.

ELECTRIC FLAT-IRON.—This novel flat iron is chambered out near its smoothing face, forming a cavity for the reception of an electrical resistance, the latter being connected by suitable wires with a galvanic battery. The face of the flat-iron is heated by the radiation from the electrical resistance. A layer of non-heat-conducting material is placed above the cavity in the iron to confine the heat to the face of the iron.

WOOD-PRESERVING COMPOSITION —A late invention mixes in the following proportions, viz: Linseed oil, one gallon; common salt, four ounces; saltpetre, two ounces; turpentine, one pint, and applies while hot. It is used for oiling fellies, and at the same time producing tightly-fitting tires. May also be applied to buckets or casks which are to stand in the sun, to prevent shrinkage or warping.

ELECTRIC INCANDESCENT LAMP.—This invention consists in a novel mode of affixing and sealing luminant carbon loops and their circuit wires vacuum-tight in the globes of electric lamps viz: first, immersing the tubes and wires in molten metal, and causing the same to rise in the tubes and around the wires; second, retaining the column of metal in said tubes and raising them out of the molten mass; and finally allowing the charge in the tubes to solidify.

EDITORIAL NOTES.

THE session of the American Association for the Advancement of Science, at Montreal, commencing August 23d, will be unusually interesting from the fact that several eminent scientific men from abroad are expected to be present, among whom are Dr. Wm. B. Carpenter, Mr. Herbert Spencer and Moncure D. Conway, of London; Dr. Samuel Haughton, of Dublin; Prof. H. Renard, of Brussels; Prof. J. Szabo, of Buda-Pesth, and Prof. Stephanesco, of Bucharest. Excursions to Ottawa and Quebec, Lake Memphremagog and Newport, Vt., besides numerous social entertainments, will be given to the members.

WE observe frequent references in the daily papers to the propriety and importance of filling the office of State Superintendent of Public Schools by the election of Prof. J. M. Greenwood, of this city, and we unhesitatingly state that in our judgment no better selection could be made, whether scholarship, experience or ability is needed.

PROFESSOR OTIS T. MASON, of Columbian College, Washington, D. C., the Secretary of the Authropological Section of the American Association for the Advancement of Science, is desirous of receiving communications and papers upon the subject, including inquiries into the origin, antiquity and primitive condition of man, his zoologic characteristics and relationships, arts and æsthetic customs, sociology and religion, to be presented to the Association at the Montreal meeting, this month.

DR. CHAS. H. STERNBERG, who has contributed to the REVIEW a number of articles on the Geology and Palæontology of the Western States and Territories, has recently returned to Cambridge from an exploring tour in Texas, and is now engaged in preparing the specimens secured for the Peabody Museum, at Harvard College.

GEN. JNO. A. HALDERMAN, of Kansas, U. S. Minister to Siam, has recently placed the Kansas City Academy of Science under obligations by sending to its library a full set of the Consular Commercial Reports.

WE have received from Prof. E. T. Nelson, of the Ohio Wesleyan University, a copy of the Third Annual Report of the Museum, by which it appears that it is in a flourishing condition. In such hands it cannot fail to become in a short time a very valuable collection.

A GOOD, soft coal, smoke-consuming furnace for heating residences, churches, stores, &c., is one of the great desiderata of the West, and it is becoming quite certain that Mr. C. C. Hare, of this city, has met the want in his "Bituminous King." The principles involved in its construction are undoubtedly correct, and he claims that its economy, cleanliness and efficiency have been fully proven.

GEN. HARTRANFT proposes to construct an electric railway in Fairmount Park, Philadelphia, after the plan of that now in successful operation in Berlin.

TEN prizes of $1200 each are offered by the Agricultural Bureau at Washington, for the best results reported by manufacturers of Sorghum sugar, and two of the same amount for similar reports by manufacturers of beet sugar.

C. F. MCGLASHAN, of Santa Barbara, California, has invented a system of railroad telegraphy by which moving trains can keep in constant communication with each other

and with stations. Two wires are used in transmitting the electric current, instead of one. Wheels or brushes attached to the moving train touch these wires carrying the current from one wire to an instrument in the car and returning it to the other wire, along which it passes until its destination is reached, when it is connected with a ground wire and completes the circuit through the earth. Its advantages are obvious, but if none were assured except that of lessening the danger of accidents, its adoption by railroad companies should be only a question of how soon it could be done.

WE have examined an invention by H. C. Train, of Kansas City, for separating gold from dirt in placer mines, and also to work at the tail of a quartz mill. It consists of an improvement in dry placer amalgamators, and its claims are set forth in the following specification: "My invention relates to improvements in machines for washing and extracting gold from auriferous deposits and crushed quartz, and separating the dirt from water after the gold has been extracted; and the objects of my invention are, first, to provide a means by which all the fine as well as the coarse gold can be brought in contact with amalgam-plates and saved; second, to separate the dirt from the water in which it has been washed, so that the same water may be used over and over again, with little or no waste, in places where sufficient water for sluice-washing cannot be had; third, to operate the whole mechanism by one shaft and the same motive power." The invention has been examined carefully by practical miners, and has been pronounced successful in its operations.

THE manufacture of water pipes was commenced on the 10th ult., at the Kansas City Pipe Works, about two miles below the city. These pipes are made on mandrels of different sizes, from three to twenty inches in diameter, by rolling around them sheets of iron heavily coated within and without with melted asphalt. When cool these pipes, now about half an inch thick, will bear a pressure of 350 pounds to the square inch, and the material of which they are composed being practically indestructible, they seem to present a cheap and effective substitute for the ordinary iron pipes.

THE Pharmacists of Kansas, at their late meeting in Topeka, elected the following officers for the ensuing year: President, F. E. Halliday; First Vice President, W. C. Johnson; Second Vice President, Geo. Slosson; Secretary, A. E. Barnes; Assistant Secretary, Frank Frisby; Treasurer, W. A. Stamford. Papers were read by Dr. R. J. Brown, F. Frisby, H. W. Spangler and Prof. G. E. Patrick.

THE Archæological Institute of America has, in imitation of France and Germany, established an American school of Classical Literature, Art and Antiquities at Athens, Greece. This enterprise has received the support of all the principal eastern universities and colleges, and Prof. W. W. Goodwin, of Harvard University, has been appointed Director for the first year, which commences October 2, 1882. It is hoped that through the co-operation of these colleges with the Institute, much practical benefit will be rendered to students in the above named subjects.

ITEMS FROM THE PERIODICALS.

IT is gratifying to learn that the *Saturday Herald*, the best society paper in the State, is gaining strength steadily, as it deserves to do, from the earnest devotion of its faithful editress to the objects of its publication.

THE *Milwaukee Sunday Telegraph*, of June 11th, contains an extended account of the principal instruments of the Washburn Observatory at Madison, Wis.

AT most of the mining camps in Colorado extensive preparations are being made for a full representation of their respective ores and minerals at the Denver Exposition this month.

THE *Popular Science Monthly* for August presents a feast for all classes of readers, as the following table of contents shows: The Physiology of Exercise—II., by Emil du Bois-Reymond; National Necessities and National Education, by Benjamin Ward Richardson, M. D., F. R. S.; Acoustic Architecture, by William W. Jacques, Ph. D., Progress of the Germ Theory of Disease, by Prof. Tyndall; A Gigantic Fossil Bird, by Stanislas Meunier, (illustrated); The Book-Men, by Hon. T. Wharton Collens; About Elephants, by Dr. Andrew Wilson, (illustrated); The Chemistry of Sugar, by Prof. Harvey W. Wiley; Transcendental Geometry; by Alfred C. Lane; My Spider, by W. H. T. Winter; Sudden Whitening of the Hair; How Plants Resist Decay, by W. O. Focke; The Topmost Country of the Earth, by Lieut. G. Kreitler; Sketch of Baron Adolf Eric Nordenskiold, (with portrait); Entertaining Varieties, Editor's Table, Literary Notices, Popular Miscellany and Notes.

PROFESSORS JOSEPH LE CONTE and W. B Rising, of the University of California, have been during the past six years investigating the alleged present formation of metalliferous veins in progress at Steamboat Springs, in Nevada, and at Sulphur Bank, California, and are now publishing their conclusions in the *American Journal of Science*. That for July, 1882, contains article second of the preliminary discussion, and the final result is promised in a later number.

MR. G. H. KINOHAN, in the London *Monthly Journal of Science* for July, antagonizes Mr. Darwin's "Vegetable Mould and Earthworms," by attempting to show that several influences are more effectual than worms in heaping up earth and mould upon surface stones, viz.: ants, winds, vegetable growth, etc.

AMONG the most interesting articles in *Van Nostrand's Engineering Magazine* for July, is one upon The Problem of Aerial Navigation as affected by recent mechanical improvements, by Wm. Pole, F. R. S., the conclusion being that "manageable balloons may form a feasible and useful addition to the present means of transport and are therefore worthy of the attention of the engineer."

Harper's Magazine for August is a brilliant number. It opens with a fine frontispiece, a full page illustration by Abbey, engraved by Closson. We note especially two bright Summer articles—both splendidly illustrated—"Some Western Resorts," by John A. Butler, and "The Cruise of the 'Nameless,'" by Barnet Phillips. For hot weather reading the description by Capt. J. W. Shackford, of the "Icebergs and fogs in the North Atlantic," will be found decidedly cooling.

THE *American Antiquarian* is now in its fourth volume and is, both from the fascinating subjects treated of and the skillful management of its editor, becoming more widely known and better sustained with each volume.

FROM the catalogue of the University of the State of Missouri for the year ending in June, 1882, we learn that there were five hundred and ninety-one students in attendance and seventy-seven graduates from the Academic, Law, Engineering, Mining, Agricultural, Normal and Medical Departments—the largest number of graduates ever sent forth from the University in one year, and the largest whole number of students for any year except the one preceding.

JNO. K. HALLOWELL, formerly of this city, who recently published a very careful and complete account of the mining and other resources of Boulder county, Colorado, is now in the Gunnison country, exploring and writing it up for the *Denver Republican*.

THE August *Atlantic Monthly* has two features which will specially commend it to general attention, namely, a fine new steel portrait of Mr. Emerson, which is remarkably satisfactory, and which is accompanied by an admirable article by W. T. Harris, of Concord, Mass.; and a Supplement containing a

full account of the Birthday Garden Party to Harriet Beecher Stowe, with the addresses, poems, and letters. In addition to this, the number contains other essays and poems, reviews of the most important recent books, and a fine variety in the Contributors' Club. Altogether, the number is one that every lover of the *Atlantic* will especially value.

IN the *North American Review* for August, the Rev. Henry Ward Beecher writes of "Progress in Religious Thought." T. V. Powderly contributes a temperate article on "The Organization of Labor." The well-known British military correspondent, Archibald Forbes, writes of "The United States Army." "Woman's Work and Woman's Wages," by Charles W. Elliott, is a forcible statement of one of the most urgent problems of our time. In a highly interesting essay on "The Ethics of Gambling," O. B. Frothingham analyzes the passion for play with rare ingenuity. "The Remuneration of Public Servants," by Frank D. Y. Carpenter, gives matter for serious consideration, both to the civil service reformers and their opponents. Finally, there is a paper on "Artesian Wells upon the Great Plains," by Dr. C. A. White, of the Smithsonian Institution. The *Review* is sold by booksellers generally.

NUMBER thirty-four of the *Humboldt Library* comprises "The Philosophy of Style," by Herbert Spencer, and a chapter on "The Mother Tongue," from Dr. Alexander Bain's work on Education as a Science. Forty-two octavo pages, 15 cents.

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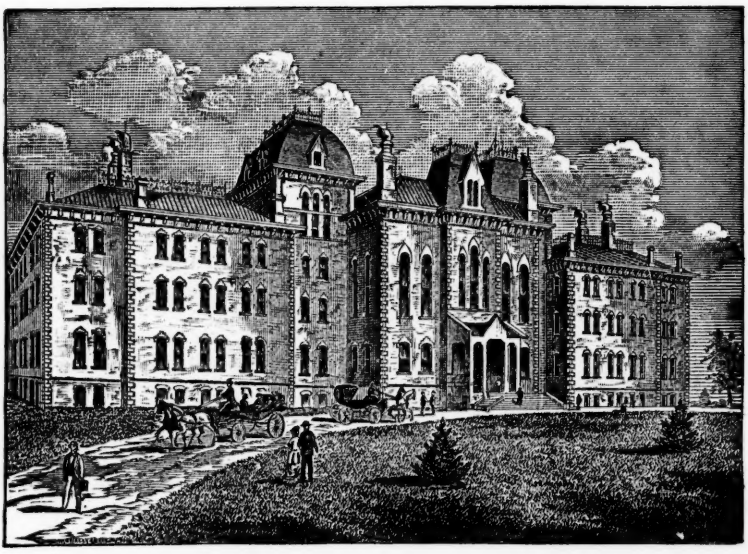

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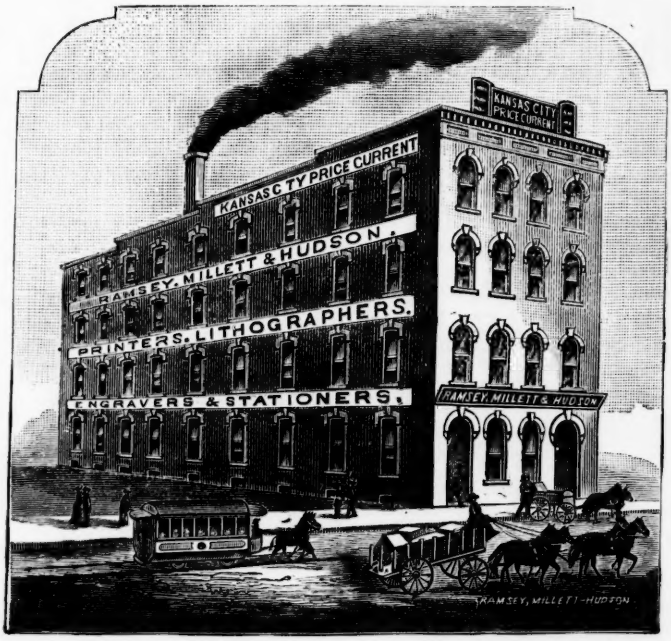

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